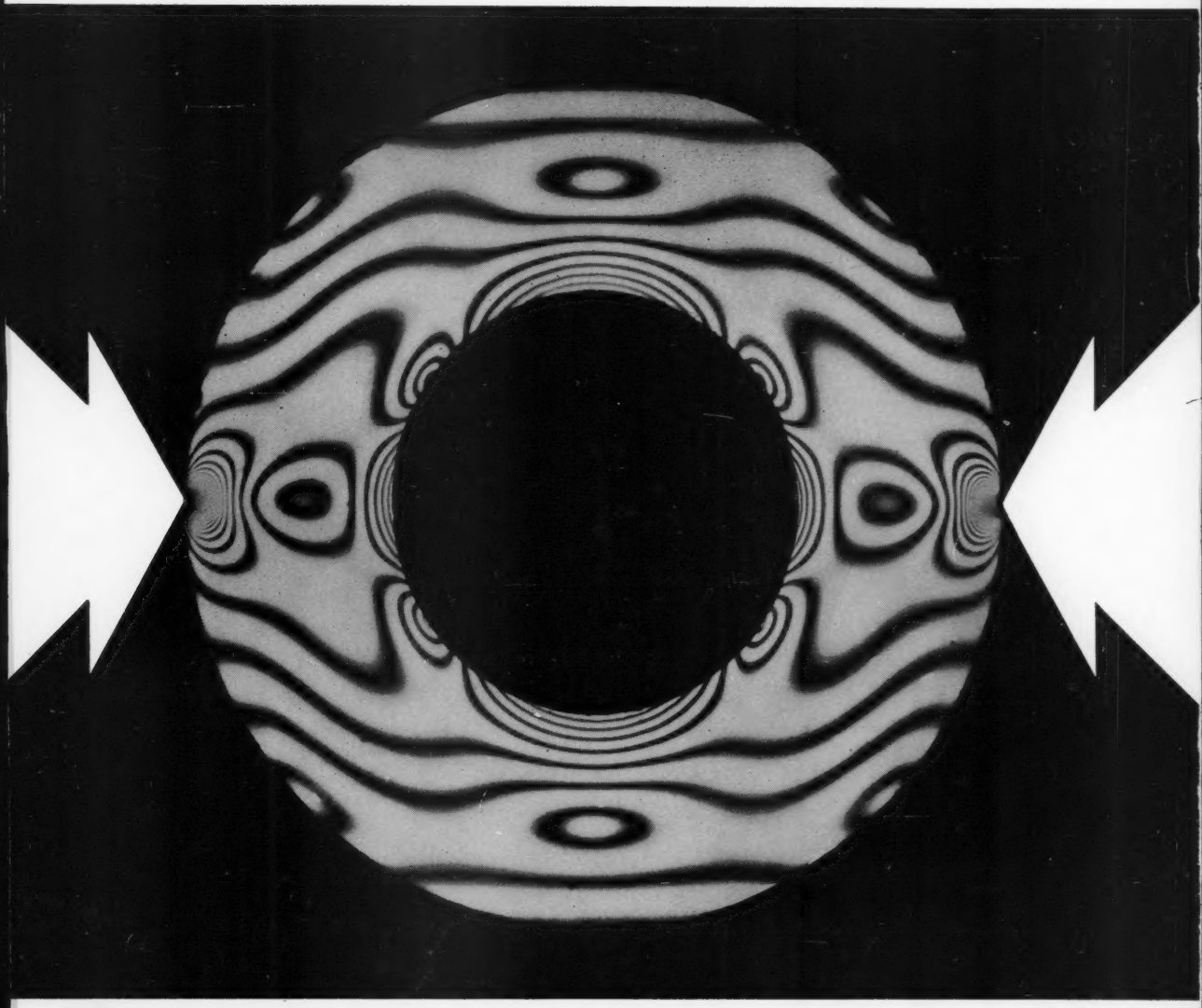
FEB 6 1956

Design Engineering

FIVE DOLLARS A YEAR



CHECK STRESSES PHOTOELASTICALLY **(page 15)**

Chromate treatment fights corrosion
Canadian boat breaks a record
U. S. develops new constant spring

December 1955

PUBLISHED BY MACLEAN-HUNTER PUBLISHING COMPANY, LIMITED, TORONTO, CANADA

He knocked on the door of the 20th century...

500 years ago!

Engineer, mechanician, inventor . . . the centuries have confirmed his immense reputation as "The Forerunner". Architect, painter, sculptor . . . his works are among the world's great treasures.

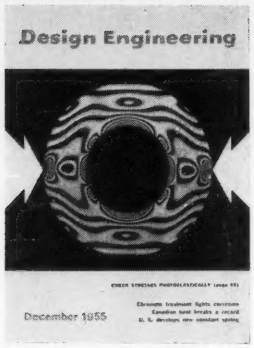
After 500 years the world still stands amazed at the intellectual vigor and engineering ingenuity of the all-capable Leonardo da Vinci. His inventions —his drawings of hydraulic pumps, machine guns, mechanical cars—his studies of gears and hoists—marvellously anticipated the engineering of the future. It is fascinating to conjecture what might have been achieved by this versatile genius had he had at his disposal all the discoveries available to his successors.

He designed parachutes, helicopters, flying machines; had he known a power like gasoline, say the experts, he would surely have completed his mechanics of aviation. And what if some of today's materials had been available to him. Aluminum alloys, for example. Their unique combination of qualities — strength, corrosion-resistance, lightness, durability—opens up a realm of possibilities to challenge even the soaring imagination of a da Vinci.

Aluminum is *the* metal of the 20th Century. It frees the creative imagination of today's engineers from the limitations imposed by heavy metals. Everywhere, more and more engineers and architects are shedding the shackles of the conventional and turning to light, strong, long-lasting aluminum.

Aluminum Company of Canada, Ltd.

Calgary Halifax Hamilton Montreal Ottawa Quebec Toronto Vancouver Windsor Winnipeg



Design Engineering

VOLUME 1 **DECEMBER, 1955** NUMBER 9

This month's cover

First cover assignment for Des English was a real problem child but posed only moderate obstacles for seasoned talent. The stress patterns in a plastic model are shown with arrows pointing to the so-called "hot spot" in the prototype. These beautiful rivulets that look like marble cake demonstrate design progress photoelastically.

Design Engineering

MEMBER

CCAB

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Report on a POWER-FULL decade

The first 10 years of jet progress in Canada is marked this month . . . a decade in Canadian creative engineering progress of high significance . . . lifting Canada to a position of eminence in the supersonic era in aviation now upon us.

1945 December 2—The Jet Age in Canada gets underway with formation of A. V. Roe Canada Limited.

1946 September—Design starts on the Orenda concept of jet power.

1949 February—First test run of Orenda 1—5,800 lbs. thrust.

1950 October—Orenda earns its wings—first flight in a service aircraft North American F86A. Over 400 contractors and suppliers recruited to provide Orenda parts and accessories.

1951 June—Orendas make first flight in Avro CF-100. Development underway on new models—more power, less weight.

1952 September—Orenda's production plant opens . . . the assembly line rolls. Power increased in Orenda 8 at 6,355 lbs.

1953 January—Orenda 10 replaces an American engine in Canadair Sabres.

1954 March—Yet more power—over 7,000 lbs.—in two-stage turbine Orenda 11 (CF-100) and Orenda 14 (Sabre 6). Both now outstanding power performers in their respective classes.

1955 December—Current Orendas deliver some 25% more power than first Orenda for 10% less weight. Close to 3,000 Orendas in six production models now in operation throughout the free world.

and for tomorrow... Under intensive development for the supersonic era, new designs with power far in excess of any current production model.

ORENDA *ENGINES LIMITED*

MALTON, CANADA

MEMBER; A. V. ROE CANADA LIMITED & THE HAWKER SIDDELEY GROUP

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Editorial correspondents in: The United Kingdom, the United States, Germany, France and Italy.

The January issue of **Design Engineering** will carry strong feature articles written by contributors no less experienced than those featured this month.

Electrically Operated Products will occupy a good deal of our January issue. Written and researched over a period of several months, it will contain many photographs and data of extreme value to the design engineer. The story is accompanied by companion features in engineering design.

Special Artwork

Editorial layouts designed by art consultant Desmond English.

Inside

Smith

Off hours, **Prof. I. W. Smith,** who wrote the intriguing story on Photoelasticity, arms himself with a camera at home and captures the intricacies of nature with his lens, But in the photoelastic lab at Toronto University which he supervises, time is well occupied with his associate professor's duties in the machine design section where he has been since 1938. Born in Galt, Ontario, he finished high school and served his time in the machinist trade before he studied Mechanical Engineering in Toronto.

Mankonen

Joining the Hunter Spring Company shortly after he graduated with his B.A.Sc. in Mechanical Engineering from the Drexel Institute, Philadelphia in 1949, **Harry E. Mankonen** has been closely associated with the Neg'ator spring. He is a member of the A.S.M.E. and the American Ordnance Society.

Endersby

Before he became manager of Ampex new office in Toronto, **Ralph E. Endersby** was an employee of Canadian General Electric and McCurdy Radio Industries in Toronto. Born in England, he served with the Royal Navy during the war and later attended London University for special training in industrial management and business administration.

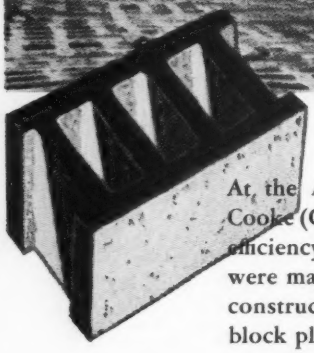
Pocock

A self-styled "chess champ" and an avid pursuer of Latin Americana, **Walter E. Pocock,** writer of the article on Chromate Treatments, is married with three children. He was a chemical engineering graduate of Johns Hopkins University in 1943, acquiring his master's degree in chemistry at Columbia in 1947. In 1950 he joined Allied Research Products after previous jobs with Du Pont where he became chemist-supervisor of the company's Chamber Works at Carney's Point, N.J.

THE "KEY" TO FASTER MORE ECONOMICAL PRODUCTION OF CONCRETE BLOCKS

Panoramic view of the J. Cooke (Concrete Blocks) Ltd. plant showing the many Goodyear Conveyor Belts which help make the entire operation proceed with clockwork smoothness.

Operation of all belts is controlled from electric push-button switches in a central control room.



At the Aldershot, Ontario, plant of J. Cooke (Concrete Blocks) Ltd., production efficiency and low-cost material handling were major objectives in the design and construction of this modern concrete block plant.

To achieve stepped-up production, at low cost per unit, an easy-to-control material handling system was put in operation. Goodyear Conveyor Belts were chosen as the "key" factors to collect and distribute materials and mixes from stock piles to final pour.

During the past fifty years, Goodyear has gained invaluable experience on how to get the most out of rubber, to save time and money in every industrial use.

Perhaps you have a problem involving material handling. If so, contact Goodyear at any of the branch offices listed below.

MORE TONS ARE CARRIED ON GOODYEAR CONVEYOR BELTS THAN ON ANY OTHER KIND

GOODYEAR

INDUSTRIAL RUBBER PRODUCTS ENGINEERED FOR THE JOB

For complete information write or call your nearest Goodyear office at— Moncton, St. John, Quebec City, Montreal, Toronto, London, Windsor, Winnipeg, Regina, Saskatoon, Calgary, Edmonton, Vancouver, or Head Office, New Toronto.

Reports

News in brief from the world's producers

TORONTO—"Meet Canada's Industrial Designers" will be the first show selected as a feature display at the new Building Centre opening in Toronto on December 5. This display, a show within a show, consists of a colorful series of stands, each presenting the work of a Canadian Industrial designer or design firm and covers a great range of products for which they have been responsible.

Besides photographic illustrations of large equipment, such as harvesters, farm tractors, home furnaces, surf boards and folding houses for A-bomb emergency evacuation, the display will show, where possible, the actual articles that have been attracting so much attention in recent National Industrial Design Council awards. These include a wide range of model hotel and office furnishings, bowling alley and school desk equipment, lighting fixtures, cooking utensils, plastic moldings, toys and packaging.

Also included are several new developments such as an efficient new type of industrial valve, a new type of translucent door and table panel made of fibreglass sheet, an electrical plug, injection-molded light diffuser, extrusion-molded door pulls, etc.

"Meet Canada's Industrial Designers," sponsored by the Association of Canadian Industrial Designers, who also have one stand devoted to an account of the association's aims and activities, will be staged independently of the main Building Centre display and officially opened a few days after the Centre is opened.

• • •

TORONTO—A new company that has set its production target for a quarter million dollars during the first year in the manufacture of cutting tools for Canada's expanding metalworking industry has been opened here.

President of the new company, **Wesson Cutting Tools Ltd.,** is H. B. Iron, who was associated with CanAero Consultants, former distributor of products for the parent Wesson company in the U. S. A former tool engineer, he asserted that one of the major reasons a plant has been established in this country is the dynamic buildup of our aviation and motor car industries.

"Canadian investment interests in the new company," President Iron revealed, "will equal the American interests in the long run."

"Standard and special cemented carbide tools will be manufactured in a new one-story plant equipped with the most modern machinery," he added.

TORONTO—Electrical fires in 1954 cost Canada $10.3 millions, the largest known fire loss for any single cause. In its October issue, **Electrical Contractor of Canada,** a business magazine, estimates that a cleanup of the wiring mess could cost the country a billion dollars.

The magazine's survey is the first recorded nation-wide investigation of the problem and covered the entire electrical industry. It revealed disturbing estimates of wiring inadequacy in industry, 59.64%, and in homes, 70.36%.

Electrical manufacturers, distributors, inspectors, contractors, fire marshals and utility executives were covered in the survey.

President of the Canadian Electrical Distributors Association, William Legallais said, "We as an industry are vitally concerned with good wiring. Power is wasted otherwise, and many appliances cannot be used or will not work right without proper wiring."

• • •

OTTAWA — The NIDC mid-November meeting has arranged for 30 prominent persons from industry and design to gather in Montreal during January to survey the possibility of a **ten-day seminar on industrial design** at McGill University in July 1956. Other decisions called for street equipment prototypes such as waste bins to be shown at an outdoor exhibition; co-operation with Canadian Homes and Gardens in organizing a second annual furniture discussion conference for April; and establishment of a speakers' bureau to lecture on industrial design to service and professional clubs.

• • •

SCARBOROUGH — "Canadian design skills have contributed much to the progress of Southeast Asia," affirmed Nik Cavell, administrator of the Colombo Plan in Canada when he inaugurated Photographic Survey Corporation's Ceylon survey recently.

Reflecting, he said, "One thing that we know and can do best, is to build power projects and carry out aerial surveys."

A copy of the NRX reactor at Chalk River, he explained, is being built for India by Canada as part of our commitments during the first five-year plan.

PSC has just completed a survey of India and will begin the Ceylon venture soon.

Of the future for design engineers outside Canada, he said: "There is a greater future for seasoned Canadian design engineers in Southeast Asia than anywhere else in the world," then added, "But these people don't want young graduates out there, they must be well qualified."

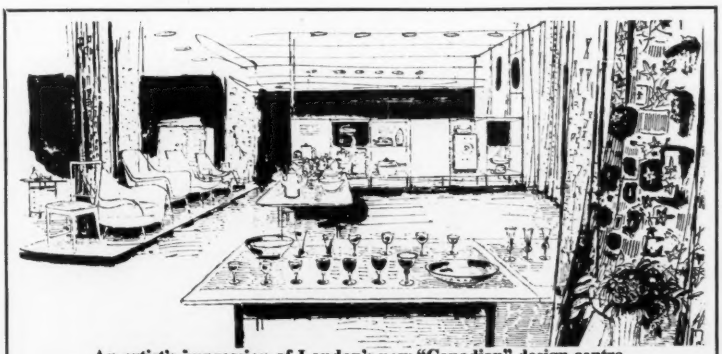
Administrator Cavell spent 22 years in Asia. He helped establish telephone service in China and Japan. Under his business guidance, Automatic Electric of Canada was built, as well as Phillips Electric of Brockville.

• • •

LONDON, ENGLAND—Britain, following the example of Canada in opening a permanent but ever changing exhibition in Ottawa, is to shortly unveil the British Design Centre at 28 Haymarket S.W.1. Pictures have just been released, one of which appears below.

Two years ago N.I.D.C. set the pattern by establishing a similar centre in Ottawa, having been formed as an organization in 1948. With the view that better design promotes better sales, the National Industrial Design Council in Canada encourages the use of Canadian talent to improve the design and therefore the sale of Canadian products abroad.

Here in London, the British Council of Industrial Design will show well-designed goods, mostly in the durable goods categories, such as furniture, textiles, carpets, pottery, glass, cutlery, domestic and office equipment.



An artist's impression of London's new "Canadian" design centre

Marconi electronic research will save you money

MARCONI'S RESEARCH AND CONSULTING DEPARTMENT offers its vast electronics experience to industry, municipalities and business generally. This puts at your service the largest industrial electronics research laboratory in Canada, and fifty years of electronic experience. You can now have your own research organization without capital investment.

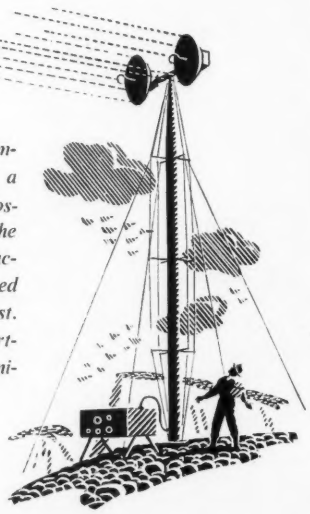
Marconi Research and Consulting Service undertakes to recommend methods of increasing operational efficiency and cost reduction through modern scientific techniques. Just pick up the phone and call Marconi's Research and Consulting Service for discussion, without obligation on your part.

Some illustrations of the scope of Marconi research:

MARCONI RESEARCH *developed the Electronic Lamplighter—to switch individual street lighting units on or off*

automatically, according to the amount of daylight. This can make substantial savings in cabling and switchgear, and has applications in industry, aviation, etc.

MARCONI RESEARCH *is completing development of a geodimeter—to make possible, for the first time, the accurate surveying of inaccessible areas photographed from the air, at low cost. (Developed for the Department of Mines and Technical Surveys.)*



MARCONI RESEARCH. *Under development is the Electro Hydrometer — to measure water levels from any remote point. This will reduce costs, maintenance difficulties and emergency installations in all types of industry, logging operations, municipal sewage and waterworks.*

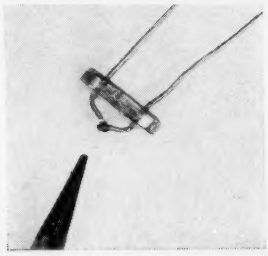
Time is valuable. Telephone Marconi's Research and Consulting Department, collect, to discuss your problems in a personal conference. Telephone number is: **Montreal, VICTORIA 3627.** *Ask for Consulting Service.*

Marconi CMC CANADIAN MARCONI COMPANY

CANADIAN MARCONI COMPANY MONTREAL 16, P.Q.

Canada's Largest Electronic Specialists

MARCONI RESEARCH *work on Ferroelectric memory devices promises significant advances in the development of new electronic computing and data processing equipment which is of such fundamental importance in the fast growing field of automation.*



THE MIGHTY

MASSEY-HARRIS

self-propelled COMBINES

sold wherever grain or rice is harvested—

are equipped with **61**

SKF

SEALED BEARINGS

Sealed bearings are one of the greatest time-saving features ever incorporated in a combine.

Approximately one hour lubricating time is saved each harvesting day.

SKF Sealed Bearings are *sealed for life.*

- **lubrication is sealed in, dirt sealed out**
- **cost of grease and lubricating time are saved**
- **smoother, quieter operation and longer machine life are assured**

CANADIAN SKF COMPANY LIMITED

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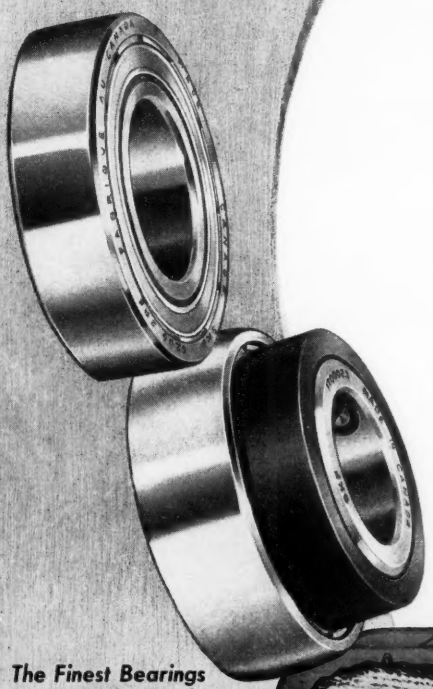
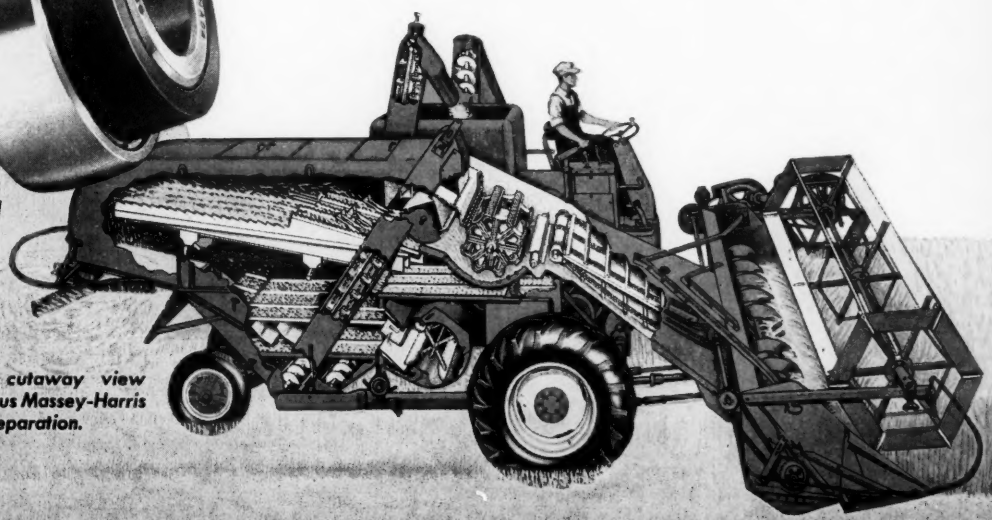


The Finest Bearings in the World



This is a cutaway view of the famous Massey-Harris balanced separation.

When you've got your eye on the one who will buy, *you use Bonderite under the paint*

PROTECTED BY Bonderite PARKER RUST PROOF CO. QUALITY CORROSION RESISTANT

BUY-SIGN for people looking for lasting finish...

Bonderite seals, furnished free to Bonderite users, promise "This product will look better longer." Six million will be used this year. Write for information on Bonderite seals for *your* product.

● There are lots of reasons for preferring Parker's corrosion resistant paint base, Bonderite: dependability, over-all economy, quality of product, results and service.

There's another advantage that's *exclusively* Bonderite's: Only Bonderite is known to *your* customer, the ultimate consumer. A quarter of a century of national advertising has established a cause-and-effect relationship between Bonderite-protection and a product that looks better longer.

Yes, when you've got your eye on the one who will buy, you use Bonderite under the paint—and use it to help you make sales.

**Bonderite, Bonderlube, Parco, Parco Lubrite, Parker Pre-Namel—Reg. U. S. Pat. Off.*

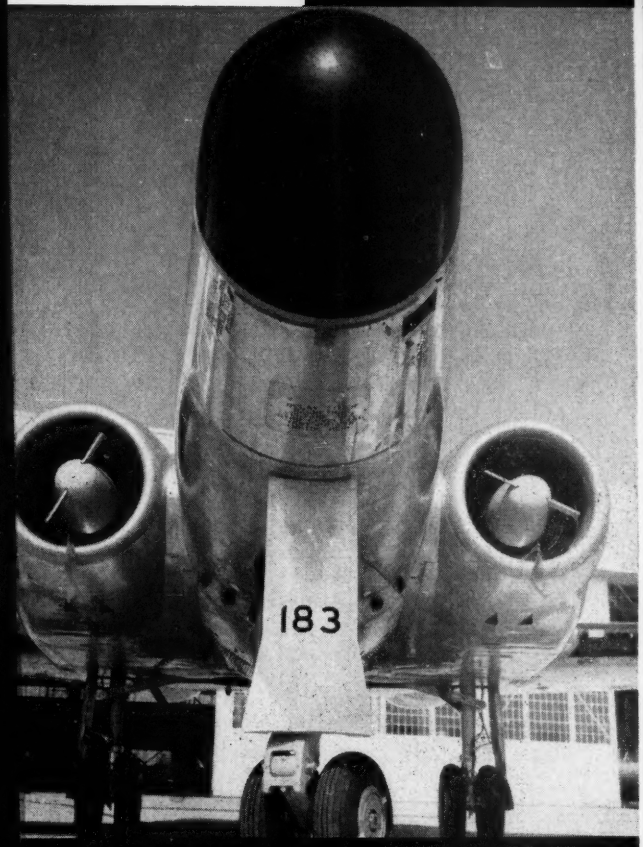
PARKER RUST PROOF COMPANY
OF CANADA, LTD.
REXDALE BLVD., REXDALE (TORONTO) CANADA

Since 1915—leader in the field

BONDERITE	BONDERITE and BONDERLUBE	PARCO COMPOUND	PARCO LUBRITE	TROPICAL
corrosion resistant paint base	aids in cold forming of metals	rust resistant	wear resistant for friction surfaces	heavy duty maintenance paints since 1883

CANADIAN INDUSTRY SAVES WITH

NICKEL ALLOY STEELS



AVRO'S CF-100 meets the terrific stresses of landing with landing gear units made from Type 4340 Nickel-Chromium-Molybdenum steel.

HIGH STRENGTH PERMITS WEIGHT REDUCTIONS

Savings with Nickel Alloy Steels begin with the important weight reductions due to inherent high strength characteristics. Thin, light sections of these economical steels provide the same strength as thicker, heavier sections of plain carbon steels. Where space and weight limitations are of importance, as in landing gear units of aircraft, this feature of Nickel Alloy Steels becomes a safety "must".

EASILY FORMED AND WELDED

Nickel Alloy Steels often contribute to lower unit-labour costs due to their excellent performance response to usual fabrication methods. They are easily formed and welded, features which are especially suited for fabricating heavy-duty equipment requiring maximum ruggedness and stamina with minimum weight.

RESISTANT TO CORROSION, ABRASION AND IMPACT

Lower maintenance and replacement costs complete the savings picture with Nickel Alloy Steels. Their high resistance to conditions of corrosion, abrasion and impact mean longer service life . . . more profitable operation.

Nickel Alloy Steels are available from Canadian steel mills in a wide range of varieties to meet specific applications.

Snowmobiles serving in Arctic cold keep vital parts strong, light and free of embrittlement failure with Nickel Alloy Steels.

Nickel Alloy Steels contribute to economical operation of refineries where resistance to corrosion and abrasion play an important part.

Light weight and high strength are vitally important in the construction of mine cars and skips, trucks and highway bus bodies.

EMBLEM OF INCO SERVICE TRADE MARK

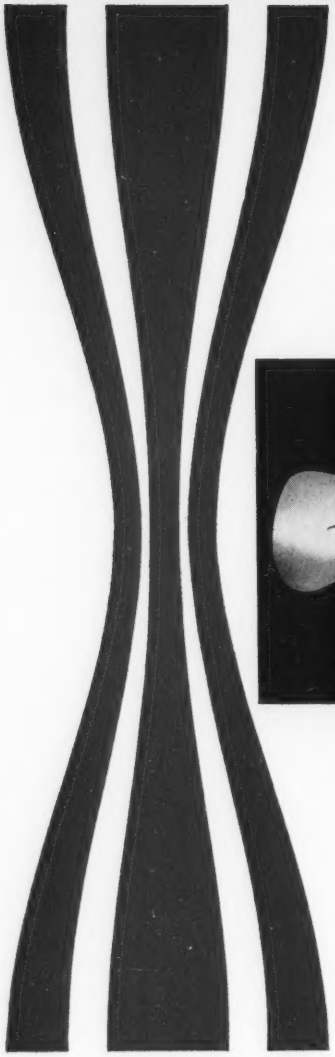
THE INTERNATIONAL NICKEL COMPANY OF CANADA, LIMITED

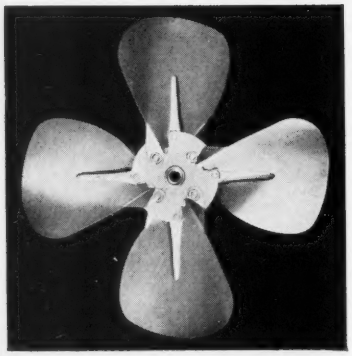
25 KING ST. WEST, TORONTO, ONTARIO

You Can Knock Down Costs

...with this knocked down fan blade

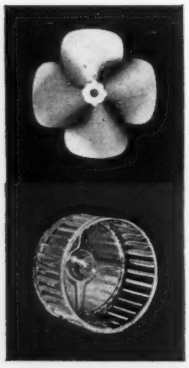
The Torrington "M" Series" master ventilating fan blade gives maximum CFM per horsepower and its quiet operation is a big selling point with customers. Best of all, the special knock-down construction saves you space and freight costs—yet the fan is quickly assembled and requires no special tools. Blades are furnished in matched sets in 24", 30", 36", 42" and 48" diameters.





The "M Series" fan blade represents only a small portion of the unusually broad variety of air impellers which Torrington produces for heating, ventilating, refrigerating and air conditioning equipment. This product range and manufacturing capacity can provide...quickly and at low cost...the fan blade or blower wheel best suited to your air-moving requirements. Torrington has extensive research and test facilities which are available to assist you in the solution of design problems relating to air flow, sound and vibration.

No one has had more experience in the design and production of air impellers than Torrington. Nowhere else can your dollars buy so much in terms of product quality and customer service.



THE
TORRINGTON
MANUFACTURING COMPANY
OF CANADA LIMITED
OAKVILLE ONTARIO
TORRINGTON, CONN. VAN NUYS, CALIF.

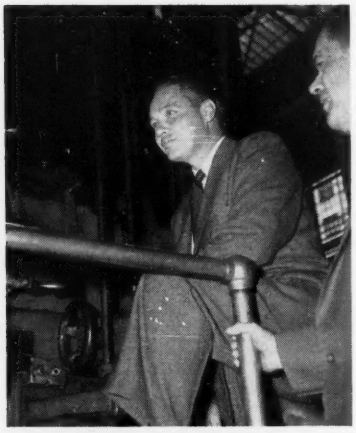
VIP's

Important people who are in the news

IN 1930, A 15-year-old native New Yorker **George Latimer Wilcox** started to work for the Consolidated Edison Company.

Today, with 25 years experience in the allied electrical fields of utility and manufacturing, he takes over as president of Canadian Westinghouse.

President Wilcox is a man of purpose. He got engineering degree at the Polytechnic Institute of Brooklyn by night study. It took eight years. By day he became expert at repairing the myriad



GEORGE LATIMER WILCOX

Greatest years of progress ahead

components in the apparatus at the Edison Company. After successive promotions, he joined Westinghouse, three years after graduation.

In 1951 he was made vice-president of Canadian Westinghouse International which has been associated with many of the projects on which he worked in the U. S.

Of Canada's industrial future, president Wilcox says: "We have our greatest years of progress ahead of us in this country, and Canadians have a set of laws and a way of doing business that can only lead to our expansion."

As a design engineer during his career, he has been a specialist in plant layout, organizing and developing better plant production techniques.

Perhaps this knowledge will be further applied in Canada as the company moves to greater automation. Another test may come when hinted-at labor disturbances have to be met in a period where unrest has flanked the production line in many important Canadian companies.

In less responsible moments away from the office, the young engineer-president relaxes with his wife Edith, and the children, Leslie 14, Holly nine, and George Jr., six. At their former residence on Long Island, he sailed a 24 ft. sloop, played indifferent golf and fished in Venezuela and Ontario.

• • •

EARLY IN 1956 RCA Victor opens new labs for pure research—fundamental to physics and electronics in Canada.

Dr. James Rennie Whitehead Ph.D., who heads the 5,000 sq ft project is one of the world's leading authorities on radar and other electronic developments. He worked closely with RCA as consultant on the McGill Fence, while he was an associate professor of physics at McGill University.

"The establishing of these new labs will induce young scientists to stay in Canada," he told Design Engineering in an interview.

Queried as to why a stay-in-Canada trend will result, he cited the broader engineering research scope in which Canadians can now operate, less restrained than in the U. S. where many young scientists are bound by lengthy security bandaging.

He lauded the new scales of pay in the labs, another solid factor in keeping Canadian engineers and scientists this side of the border.

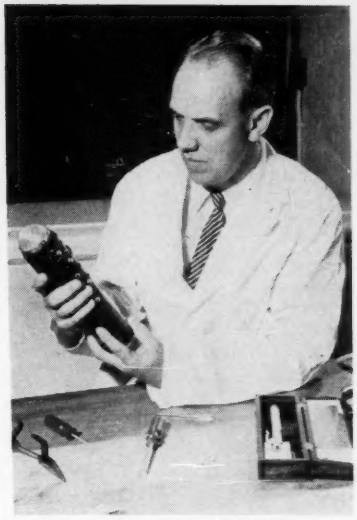
English-born, and educated at Manchester and Cambridge Universities, the 38-year-old laboratories chief was with the British Government Telecommunications Research Establishment from 1939 to 1951, working on important war and defense jobs.

Work on the Mark I prototype aircraft system for radar identification thrust his promotions to the extent that he actually designed the Mark III airborne equipment fitted to all allied ships and aircraft.

In June 1944, Dr. Whitehead was made a member of a four-man War Cabinet mission to the Joint Chiefs of Staff in Washington.

At the end of the war, he returned to the U. K. and headed a radar research division. On loan next to a Cambridge research group, scientist Whitehead at the same time did his own research project on friction, which led to his Ph.D. degree. He came to Canada in 1951.

"How will the new laboratories affect design engineers?" he was asked.



DR. JAMES R. WHITEHEAD

World's authority on radar

"Our research—while fundamental—will reach deeply into the broad field of company operations, supplying basic information to assist product designers," he replied.

• • •

THE DEFENSE RESEARCH Board, was recently faced with the problem of finding a new chairman when Dr. O. M. Solandt stepped down to go into the railway business as assistant vice-president of research and development of the CNR.

The head of the 14-member board has a status as deputy-minister, and the position is parallel to that of armed services heads. It is not an easy niche to fill.

The prescient and venerable board found within its own ranks a man with the exacting background and experience needed. Indeed, **Adam Hartley Zimmerman** had been a DRB member since February 1952.

Hamilton born, chairman-elect Zimmerman is 53 years old. He has been associated with Ottawa's production carousel since 1941, when he first served as director of small arms production.

His quality of leadership was early recognized when he was awarded the Governor-General's Silver Medals at the Royal Military College.

After he graduated in Mining Engineering engineer Zimmerman spent four years underground at Timmins. His underground service was climaxed by his narrow escape in the disastrous Hollinger mine fire of 1927.

Chairman Zimmerman, who assumes his new duties next spring is a family man. With his wife Ethelwyn who he met in his college days and a grown son he enjoys leisure hours at his cottage.

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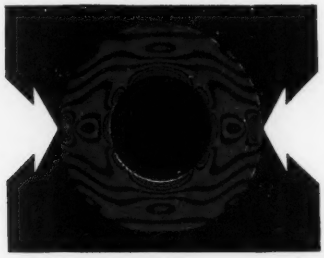


Seek Stress Value by Photoelasticity

A transparent plastic model scaled to the prototype and subjected to load, gives the visual stress answer in design when other ways fail

By **PROF. I. W. SMITH**
UNIVERSITY OF TORONTO

THE PRODUCT DESIGNER is responsible for incorporating in his design a combination of satisfactory performance, attractive appearance, safety, and economy in materials, manufacture, operation and maintenance. While his calculations must be exact, he may be faced with situations in which standard methods will not work. Picture 1 shows three examples where the usual P/A or Mc/I formulae do not give the critical stress value.

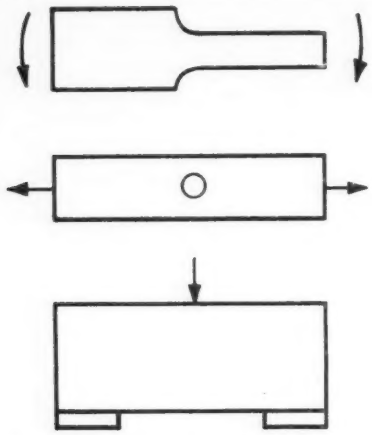
Photoelasticity is an experimental method for measuring stress where the direct use of recognized formulae becomes too difficult or leads to wrong answers. To solve a stress problem photoelastically a transparent plastic model, accurately scaled to the prototype, is put under an equivalent system of loads. Polarized light, passed through the stressed model, produces a pattern of "isochromatics" or "fringes" which determines the principal shear stresses throughout the model and the maximum tension or compression stress at the free (unloaded) surfaces. With somewhat greater difficulty, the principal stresses may also be determined for interior points in the model, but these are usually of less interest than the boundary stresses. When *white* light is used, the fringe pattern appears in vivid color, but the patterns obtained with *monochromatic* light are far superior and it is common to sacrifice beauty for utility. **(Continued on next page)**

This explains photoelasticity in a brief capsule

Professor Smith's article is intended to outline some photoelastic techniques without delving too deeply into theory. The basic principle involved is the phenomenon of a ray of polarized light passing through a bi-refringent material, wherein it is resolved into mutually perpendicular vibrations which pass through the material at different velocities. The amount of phase difference at emergence, when interpreted through an "analyzer" polaroid, produces the light and dark areas of the photoelastic pattern. The amount of bi-refringence depends on the difference between the principal stresses at a given point; the direction of resolution is that of the principal stress axis. The fringe order is the number of phase-change cycles produced by a given principal stress difference p — q and is expressed by the formula $n = \frac{d\,(p - q)}{C\lambda}$, where d is the length of the path through the material, C a sensitivity coefficient for the material and λ the wavelength of the light.

Photoelasticity *(continued)*

From the moment the load is first applied to a photoelastic model, positions of stress concentration or "hot spots" at the free boundaries show. These indicate the need for redesign, and through modifications of the plastic model the progress of design improvement shows easily. The plastic model is usually made faster and cheaper than that for the metal prototype. Design checks can be made in the early stages of development, before actual components are available for strain gauge or brittle laquer testing.



Picture 1. Examples where usual formulae do not give the critical stress value.

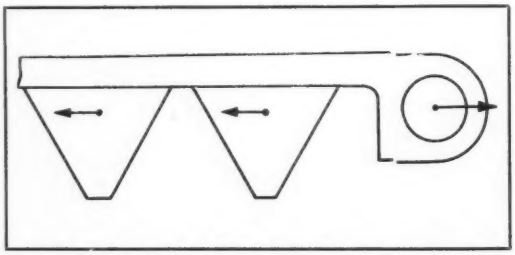
Picture 2a shows the driving head of a reciprocating mower knife. It is subjected to rapid reversals of load, and when increased speeds were in mind a photoelastic study showed that failure would begin in the fillet. Picture 2b indicates a stress increase of 1.6 at point A. The design of picture 2c was an attempt to reduce weight and provide a smoother stress path, but very little reduction in critical stress was obtained. In the final design it was possible to remove the flange, and by improved stress distribution the "hot spot" was almost eliminated, as shown in picture 2d.

Pictures 3a and 3b show the fringe patterns for rings, loaded in diametral compression. The variation in stress along the external surfaces may be calculated, but the computation involves several days of work by the usual methods. The two photoelastic models, which required less than two hours to make and photograph, indicate the stress distribution directly. These are from a series of models in which the ratio of inside to outside stress was obtained, as shown in picture 4, in designing dynamometer rings. Strain gauges connected in adjacent arms of a wheatstone bridge, are attached at 90 degrees from the load points, on the inside and outside surfaces of the rings. Errors in linearity are produced by variation of stress along the gauge length and by unequal stress values inside and out as the ring thickness increases, and these were evaluated photoelastically.

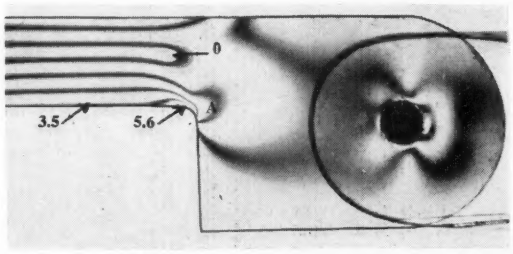
The two examples shown are *plane stress* problems in which the loads act in one plane, and the thickness perpendicular to this plane is relatively small and uniform. The more general case is that of *three-dimensional* or 3-D stress, where the loads are not coplanar and the part is not necessarily of uniform thickness.

The photoelastic procedure for *plane stress* problems is relatively simple. The model is cut from a sheet of polished plastic and placed in a loading frame. A beam of light, polarized by passing it through a sheet of

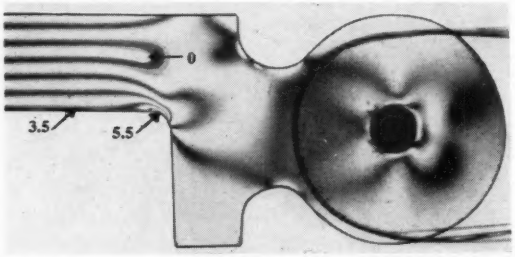
Photoelasticity shows design progress in cheap plastic prototype



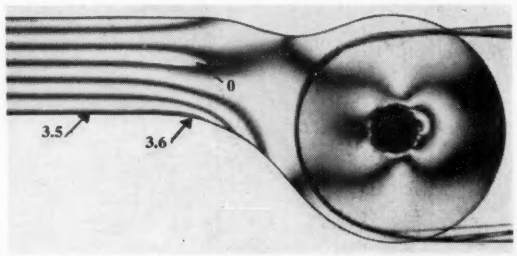
Picture 2a. Driving head of reciprocating mower knife.



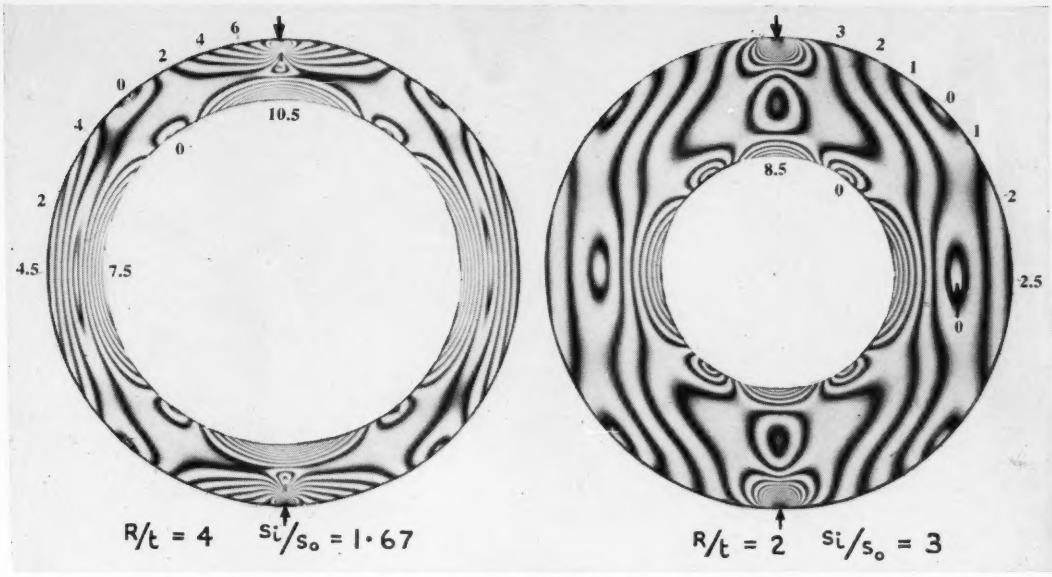
Picture 2b. Indicating stress increase of 1.6 at point A.



2c. Attempt to reduce weight and give smoother stress.



2d. Better distribution almost eliminates hot spot



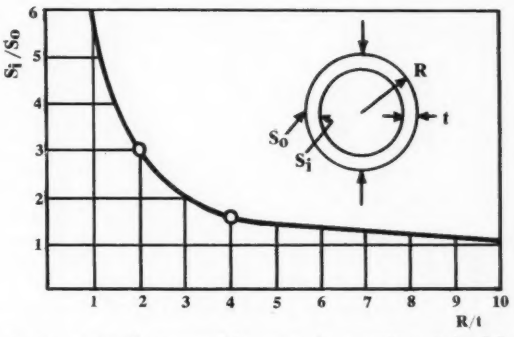
Pictures, 3a left, and 3b right, indicate stress distributions for rings loaded in diametral compression.

Polaroid, is put through the model exactly perpendicular to its surface, and through a second Polaroid called the analyser. The resulting fringe pattern shows on a ground glass screen or may be photographed. This equipment is called a transmission polariscope, and may either use a concentrated light source with a condensing lens system, to make the beam parallel where it passes through the model, or a diffused light source of considerable area, at some distance away from the model, so that rays reaching the model are substantially parallel.

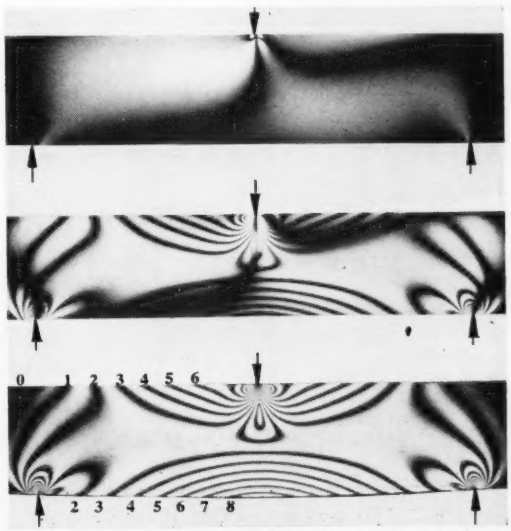
Light passed through a Polaroid is *plane* polarized, which means that its vibrations are orientated in the direction of the Polaroid's axis. The dark lines of picture 5a are the 10 degrees isoclinics of a beam, showing the locii of points at which the principal stress direction is 10 degrees from the vertical, the angle at which the optical axis of Polaroid was set for the photograph. Other isoclinics are obtained by merely rotating the polaroid, and a family of isoclinics may be used to obtain the stress trajectories throughout the model. White light is used to obtain isoclinics, so that the fringes will be subdued to make the isoclinics stand out. For picture 5b, the light source was a 100 watt mercury vapor lamp, giving a monochromatic light having a wavelength of 5461 Angstrom units. Using plane polarization, the isoclinics and fringes are of equal density and, being superimposed, result in a confused picture. By adding quarter wave plates to the polariscope, circular polarized light (instead of plane) is obtained and the isoclinics disappear, leaving the fringe pattern clearly and sharply defined, as shown in picture 5c.

Some materials are insensitive

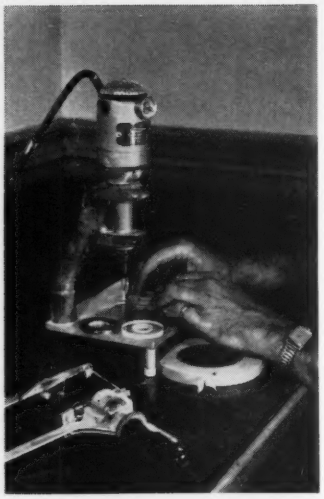
Many transparent materials exhibit the stress-optic (bi-refringence) effect but are not all equally sensitive. Glass, celluloid and Lucite have low sensitivities and are not usually used. A plastic known as CR-39, and supplied in polished sheets of various thicknesses by the Homalite Corporation of Wilmington, Delaware,



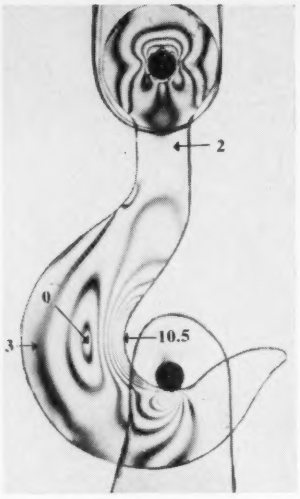
Ratio of inside to outside stress in a series of models used in designing dynamometer rings is shown above.



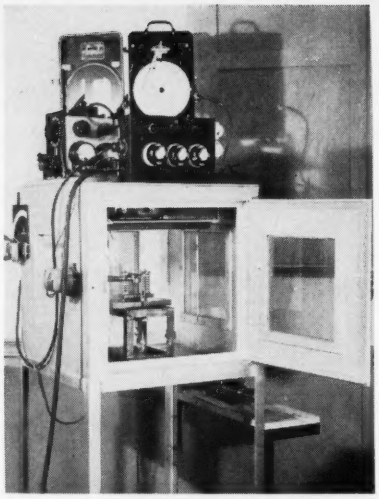
Picture 5. (a), Isoclinics of beam, locii points; (b) isoclinics, fringes, equal density; (c) isoclinics disappear.



Picture 6, shows router, saw used for roughing model and adhesive.



Picture 7. Stress is given in ratio to stress eleswhere.



Picture 8, showing oven used for frozen stress work at university.

Plastics used, subject to creep, fail to give full strain in model instantly

Photoelasticity *(continued)*

is a suitable plastic for plane stress models and has largely replaced Bakelite BT 61-893 and Catalin 700. Great care must be exercised when machining the edges of the model because if heat is generated a stress will show permanently at the boundary. Since the stress concentrations to be studied are usually at the surface, it is most important to have it initially free of stress. Chapman Laboratories, of West Chester, Pa., supply a high speed router that uses a fine toothed tungsten carbide cutter, rotating at 22,000 or 45,000 rpm, to follow a metal template that is attached to the CR-39 model material. This is shown in picture 6, together with the saw used to rough out the model, to within 1/32 in. of the finished size, and the double adhesive tape used to attach the template to the plastic. By using a keen cutter and light cuts, it is possible to produce a stress-free model. However, deterioration of a freshly cut edge commences immediately and this leaves a tension stress or "rind effect." Coating the edge with transparent nail polish delays this but the model must be examined within hours of its manufacture.

Speed at this stage is important. Although photoelasticity is a simple method of stress analysis, it needs ordinary care. This small inconvenience is part of that care.

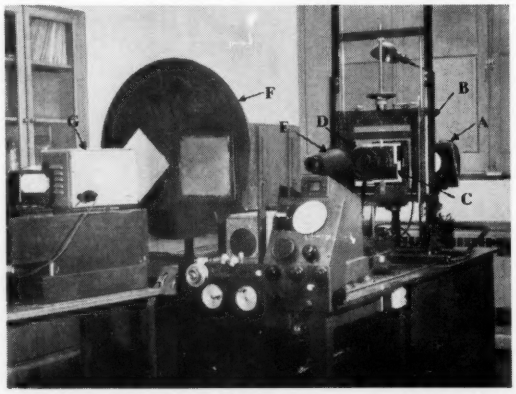
Unstressed points in a model will have a zero fringe order and no change will take place here as the load is applied. The fringe number or order increases numerically from the zero fringe and the stress along a free boundary will be in direct proportion to this fringe number. The top corner of the beam in picture 5 is unstressed and hence fringe numbers may be counted from it. The spacing of fringes along the bottom shows the stress increasing uniformly toward the centre. The stress value in terms of fringe number is obtained by loading a calibration specimen of plastic. This calibration piece is made and loaded so that it will have a known stress value, such as direct tension or compression, or stress due to bending, and, if it is the same thickness as the model, the stress

(Continued on page 56)

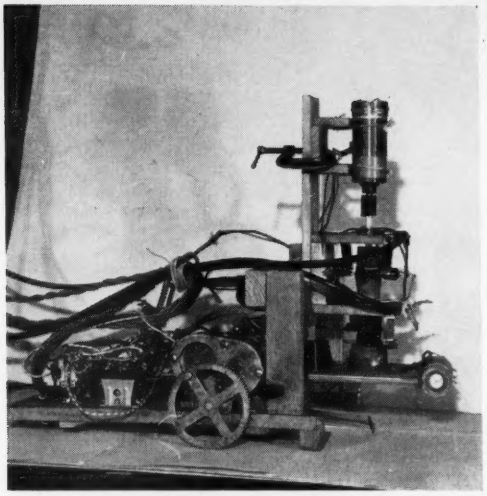
Books on Photoelasticity

Treatise on photoelasticity, Dohen and Filon
Photoelasticity (two volumes) M. M. Frocht
Introduction to experimental stress Analysis Lee
Handbook of Experimental Stress Analysis Hetenyi

The full story of photoelasticity is long. Readers who want more details than can be given in one story will find most questions answered by these books.



Picture 9. Concentrated-light-source transmission polariscope, Mechanical Engineering department, Toronto.



Early "crab" model, above, has been streamlined, with servo mechanism on same carriage as Geiger.

An Automatic Crab Traces Wireworms

WHAT'S THE FUTURE in tracing wireworms, the cable-like, half-inch long larval of the beetle family? In a country where the growth of our forests and agricultural crops means the difference between abundance and failure, it is important to insure a constant reproduction free from the hazards of insects and other pestilences. Steps to combat the particularly destructive larval of the "click beetle" are being taken at the University of Saskatchewan, because of its attack on wheat and corn. Other species of the wireworm are enemies of the roots of trees and shrubs.

So there is a rewarding future in following the movement of these subterranean dwellers. A crab-type device developed by B. C. Green and J. W. T. Spinks, professors at the university, hovers over a circle where insects tagged with radiocobalt (CO-60) have burrowed.

Previously, the gamma rays emitted by the radioactive worms were detected by a hand-operated Geiger probe, which was moved around for the maximum response. The position of the tagged worm corresponded to the maximum response from the counter.

Now, an automatic device follows and records the position of a tagged insect continuously.

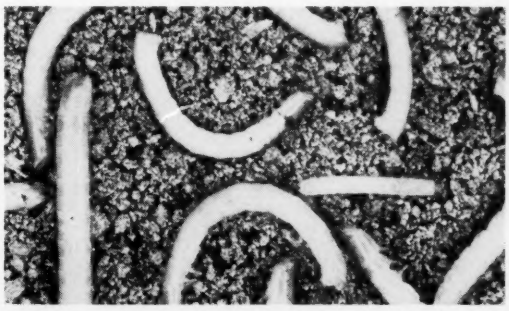
Its sensing element is a thyrode tube, Victoreen Co. 1B85, that is rotated about a vertical axis at the end of a fixed arm. The longitudinal axis of the tube lies in a plane parallel to the operating soil. This axis is tangential to the circumference of a circle lying in this plane and about whose centre the arm supporting the Geiger rotates.

If a radioactive source lies on the axis of revolution, the distance between the source and the Geiger tube will not vary during a revolution, and the counting rate of the Geiger tube per unit of revolution will be constant, except for radioactive disintegration and background fluctuations.

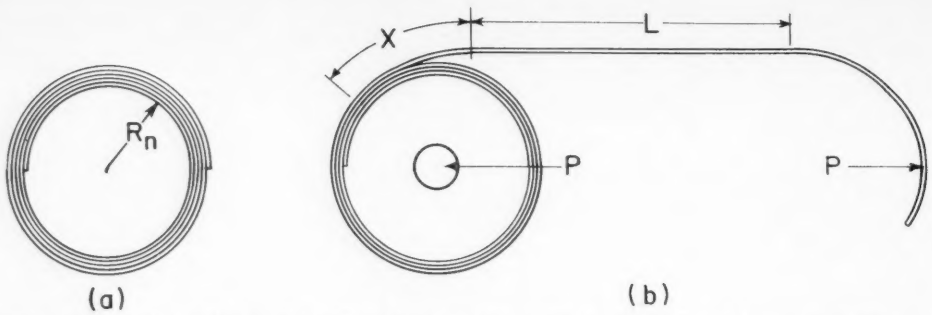
On the other hand, if the source does not lie on the axis of revolution, the distance between the tube and the source will vary during a revolution. The count rate generated per unit angle of revolution will not be constant during a revolution, and will tend to be higher in those areas where the Geiger tube is nearest the radioactive source. This variation, which is superimposed on the usual background, can be used to operate a servo-mechanism that causes the axis of revolution to come closer to the radioactive source. The Geiger tube and servo-mechanism are carried on a free-moving carriage capable of a crab-like motion. All translatory movements of the axis of Geiger revolution are recorded on the operating surface by a stylus which is almost co-incident with the axis.

A record of the time when the machine and the wireworm were in the given position is made by a clock-driven printing wheel that carries suitable marking symbols to represent the time. At intervals, the wheel is inked and pressed momentarily against the soil. A record of the distance of the radioactive worm from the soil is given also.

Able to home onto a wireworm with 20 microcuries of CO-60 from a distance of about 15 inches, the apparatus can follow a tagged insect through 4 inches of soil with a position error of about ¼ in. It can operate at wireworm speed. ★



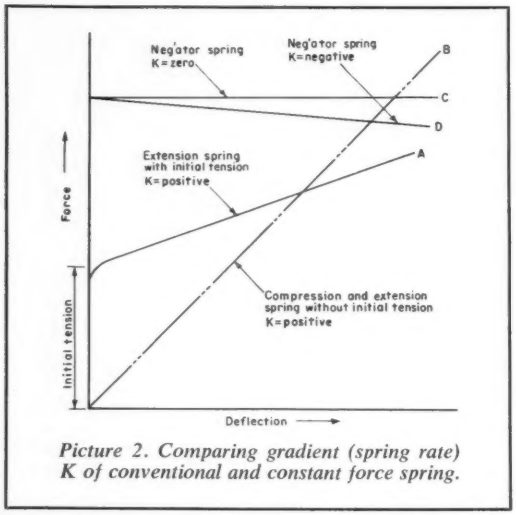
Inches per hour, wireworms edge through the soil.



Spring relaxed (1a) and uncoiled (1b), with restraining force P constant, exhibits a zero gradient.

Flat Spring Exerts Constant-Force

Simplifying mechanical loading, Neg'ator spring forms tightly wound spiral



Picture 2. Comparing gradient (spring rate) K of conventional and constant force spring.

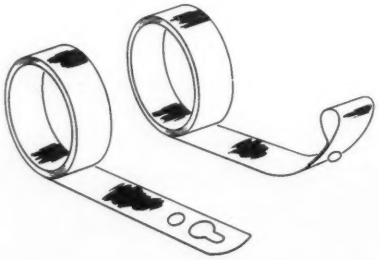
By HARRY E. MANKONEN
HUNTER SPRING COMPANY

SINCE IT WAS INTRODUCED to industry six years ago, the Neg'ator constant-force spring has simplified the solution of many mechanical loading problems which before required bulky or complicated systems for constant loading. Neg'ator springs, in a wide range of sizes, are used today in different ways in a wide variety of mechanisms.

The Neg'ator spring, first spring to exhibit zero gradient, is a strip of flat spring material which has been curved by prestressing and thermal processing so that in its relaxed or unstressed condition it forms a tightly wound spiral. In picture 1a the Neg'ator band is in its relaxed position and no part of the spring is stressed by external causes. The outer end of the spring in picture 1b has been extended by force P and, with the coil mounted for free rotation, has been partially uncoiled.

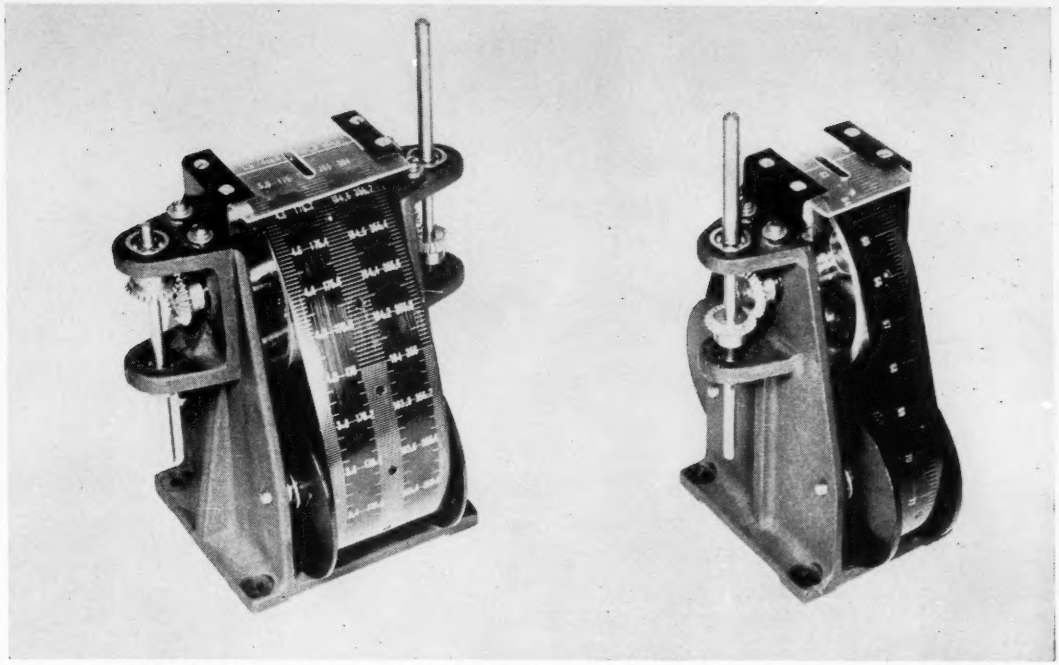
The force P necessary to restrain the spring, is determined only by the work required to straighten

Five major forms of the constant-force neg'ator spring are illustrated at right



Neg'ator constant force extension spring.

"A" Motor.



Picture 3. Spring bands used as expanded direct-reading scale on computer give deviation of .0033 per cent.

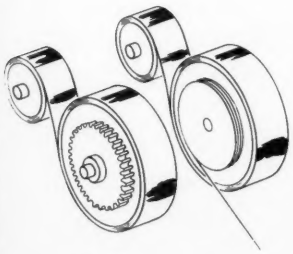
material through zone X from its coiled condition. Force P is therefore constant and independent of extension, as long as each incremental length of the spring undergoes an equal increase in stresses as it is straightened. This condition represents a Neg'ator spring having a zero gradient. The incremental stress increase occuring in zone X can be varied in manufacture, and a negative, positive or changing gradient obtained, but the zero gradient spring has found the greatest use.

Picture 2 shows typical force-deflection curves of various spring types compared to the force-deflection characteristics of the Neg'ator spring. It is impossible to obtain more than an approximation of flatness in the force-deflection of the normal extension spring—even in the most unusual cases, where force requirements are low and where it is possible to use springs that are very long in their range of useful deflection.

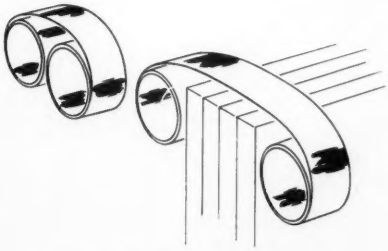
The Neg'ator constant-force spring is characterized by these five remarkable properties, even extension:

- Flat, receding, or slowly rising force-deflection characteristics.
- Enormous expandability in range of action. Deflections as high as 30-50 times the original dimensions of the unloaded spring are practical, in contrast to the usual extension spring which expands only ½ to 2 times its original length.
- The ability to act without losses or inaccuracies around corners, through small openings, and with the same freedom as non-elastic bands or cables.
- High force, even up to maximum rating, available at beginning of stroke.
- The ability to store and deliver twice as much energy as an ordinary spiral or power spring occupying the same space.

These properties have led to the development of the five major forms of the Neg'ator spring shown in diagrams. They do not, however, exhaust the possibilities; they are only representative. **(Continued over page)**



"B" Motor.



Neg'ator clamp, rigid, effective.

Another application, the clip.

Neg'ator Springs *(continued)*

Basically, the Neg'ator is used as an extension spring. With the coil tightly wound on a bushing, extending the free end of the spring from the spiral is constantly opposed by the tendency of the material to hold or restore the curvature put into it in manufacture. If given a zero gradient, the spring will oppose extension with a constant force throughout long deflections as compared to its unrestrained dimensions.

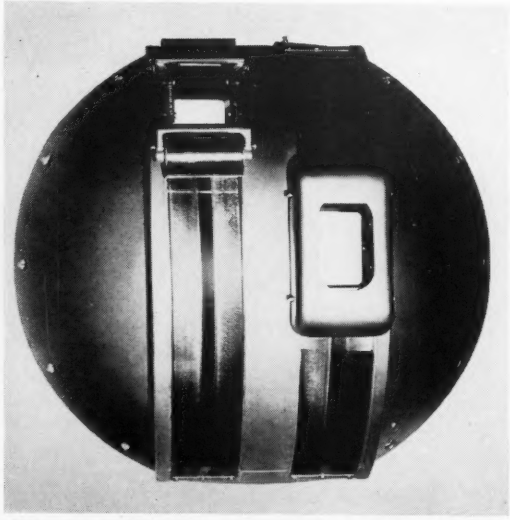
Two forms of the Neg'ator may be used to deliver a constant torque to an output bushing. In the A motor, the free end of the spring is wound on a second drum which has a larger radius than the storage bushing. The second drum holds the spring only so long as its rotation is restrained. When released, the tendency of the material to recoil to its present curvature causes it to rewind onto the smaller drum, putting a constant output torque to the shaft of the larger drum.

The Neg'ator B motor is more powerful than the A motor because the spring is reverse-bent upon a large radius output bushing. Thus its impulse to recoil to the smaller storage drum is greater, so providing a higher torque with a more highly stressed unit and, some sacrifice in fatigue life.

Several B motors driving one output drum or shaft make up a multiple B motor. Arranged around a single output drum, the springs will deliver the sum of their available energies to a single shaft.

The Neg'ator clamp is similar in construction to the extension spring. Both free ends of the material form coils, and a clamping pressure is obtained between the coils. The opening between the coils is limited only by the length of material in the spring, and clamping pressure is constant and independent of the width of the opening.

Since a coiled Neg'ator spring can be expanded in diameter, or even straightened out completely, without permanent deformation, it may be used as a circular retaining band or clip. In attempting to return to its preset curvature, such a relatively thin band can exert an unusually strong embracing force. However, this embracing force will not remain constant but will depend upon the amount the clip is expanded beyond its initial diameter. Thus the five forms of the Neg'ator spring provide four basic mechanical elements: an extension spring, a motor, a clamp and a clip.



Picture 4. Balanced constant-force springs provide closure for slots in radar-controlled tail turret.

The constant-factor idea immediately suggests many applications where a load is applied to hold traction, friction, or contact pressure between two members, or to take up slack in a flexible member. Dead weights or spring loading have been familiar methods for accomplishing this, but the extra weight and bulkiness of dead weights, the design of compensating linkages, or the need for repeated adjustment of spring mechanisms are continual problems. Typical of the many applications in which the Neg'ator has provided this required constant force is in a commutator brush rig picture 4.

Another use of the constant-force spring is as a counter-balance. Since its weight is only a fraction of the force it can exert, its application as a counter-balance results in considerable savings in over-all equipment weight. Neg'ator springs used as window sash counterbalances are 60 times lighter than the dead weight mechanism it replaced. Additional advantages arise from resulting simplifications in design. Cables and pulleys can be eliminated, or simplified. Freedom of mounting and location and valuable working space are gained. Operation and mobility of equipment is made easy and very long travel is possible without the need of structural accommodations for a secondary mass.

It will counterbalance tools, berths

Covers, doors and windows, especially in airborne equipment, are typical applications picture 5. Neg'ator springs and motors also counter-balance berths, fire doors, production tools, instruments picture 6 and similar equipment.

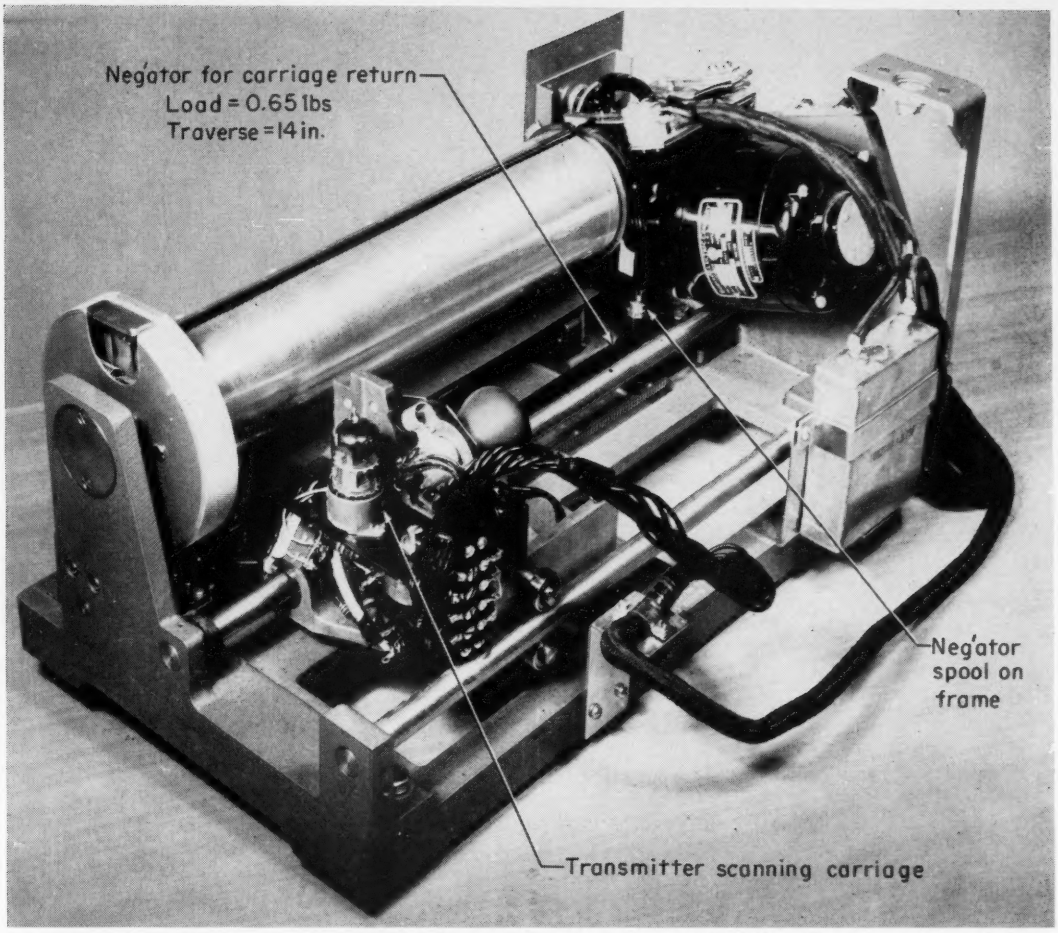
In its motor form the Neg'ator spring offers an ideal medium for maintaining tension on or retrieving reeled-out material. Neg'ator powered reels can include several times as many turns as ordinary spring powered types, without the heavy pull back at full extension. Besides the constant-pull hose reel device Neg'ator motors retract steel tapes, electrical cables and air lines and other supply connections normally stored on drums.

The Neg'ator spring in its motor form also provides a compact, powerful drive unit. It can operate in hazardous atmospheres where electrical drives are prohibited and is particularly useful in equipment which must be small and light or which must be independent of an external power source. It is capable of driving for a considerably longer time than conventional mechanical motors and it will deliver a constant torque throughout.

A Neg'ator B motor has made possible a continuous drive of about 3 lb. in. torque for uninterrupted exposure of 40 ft. of film in a motion picture camera. A comparable conventional spring would have required several times the space and extremely rugged parts to handle the maximum torque developed. In a parachute-borne heavy duty testing instrument a Neg'ator B motor provides a constant torque film drive under rugged operating conditions.

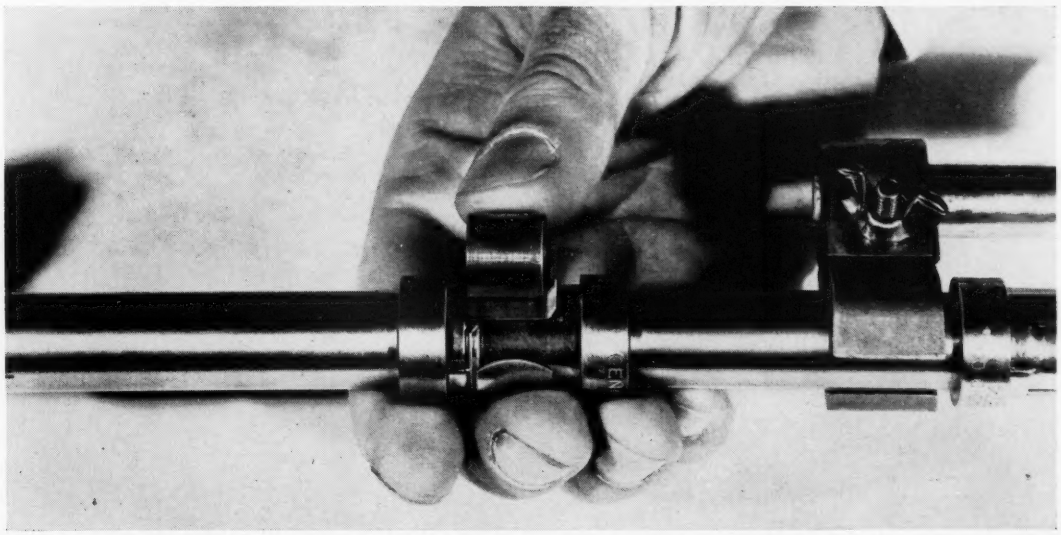
As a returning or retracting force, Neg'ator springs or motors are useful in providing the one-way motions which are encountered where a part passes through a limited stroke and is returned to its initial position to begin the next stroke. Less surplus energy is required to charge the Neg'ator than that required to charge the

(Continued on page 60)



A zero gradient spring on carriage of facsimile transmitter exerts force of 0.65 lb. without excessive acceleration.

In various phases, constant-force spring is a valuable design component



Picture 6. Clip used as wrap-around clamp joins coaxial electrical connectors at rigid mating junction.

EMI Plant Yields

Complex manufacturing plan produces a steady stream of TV picture tubes for the HMV and Marconiphone in UK

BY LEO WALTER
CONSULTING ENGINEER (GREAT BRITAIN)

Rotary shaking machine, E.M.I. product, cleanses tube with marble chips, followed by an acid-water solution.

Tubes are removed from conveyor after annealing in furnace to relieve stresses due to working of glass.

At the E.M.I. two and a quarter million dollar plant at Hayes in Middlesex seemingly disconnected operations are integrated to produce a steady stream of cathode ray tubes (the company calls them Emiscopes) that go into the H.M.V. and Marconiphone sets. The entire plant layed out on one floor was designed with a speedy and efficient production of TV tubes in mind, and this has been accomplished by a complex manufacturing plan.

But before the various operations are dissected, there is the basic tube itself to consider. It has three parts: the electron gun; the glassware and the fluorescent screen. And it makes no difference whether the gun is the tetrode now in general use or the triode, the principles of manufacture are the same.

Electrodes are blanked out from strips of cupronickel alloy, except the cathode which is made from a specially pure nickel. Metal parts then go through a "de-greasing" process and then to the de-gassing plant where a series of critically controlled furnaces hold them at a steady temperature of 1,000 deg C. In tube manufacture unwanted gases arise because of the materials used in building the components, so the parts are held in the furnace at least an hour to eliminate all traces of gas which possibly might cause tube softening later.

The heaters, consisting of fine molybdenum-tungsten alloy wire are being made at the same time on the assembly line. Their construction, considered somewhat orthodox, is nonetheless effective in preventing premature failure of the heaters and the heater cathode shorts due to insulation breakdown. Coated with the insulating material first, they are then wound into tiny cylindrical coils which are later inserted in the cylindrical cathode. Remaining in a semi-plastic state, the insulation sets permanently when the component is fired.

A tiny tube topped with the material that emits electrons, the cathode nestles concentrically inside the cup-shaped grid, fixed there in the proper position by a ceramic washer, which must be accurate to the thousandth of an inch. It must also conform to exacting specifications as to its insulating properties. E.M.I. engineers have discovered that careful calculations in the shape of the washer can defeat the problem of electron spray putting a coating on it which could provide a leakage path between the grid and cathode. The cathode is pierced with six holes. A concentric ridge and the

Cathode Ray Tubes

centre of the washer is cut away so that only a third of its total circumference actually touches the grid.

Vital mechanical accuracy is followed in the structure of the entire gun which ensures not only assembly line tolerances but equal accuracy during the service life of the tube.

Handled as delicately as soap bubbles, the tubes must not have the face of one brushed against another. If it does happen there will be scratches which show up as the tubes becomes filled with dust. To eliminate this hazard, the tubes after a preliminary washing, are protected by a broad collar of soft rubber. They are never allowed to stand without protection to their faces.

Grease and ordinary impurities are removed in the first wash with a caustic soda solution. However, demineralized water as pure as double distilled water must be used in the final wash.

Next, the anode connection is inserted in the side of the tube. This consists of a glass plug coated with a platinum film melted into the tube with a blowtorch, which produces a permanent and leak-proof seal.

Coating the screen is difficult

Most difficult operation in the construction of the cathode ray tube is the placing of the deposit on the fluorescent screen and the aluminized coating. What is specifically called for here is a perfectly smooth coating of fluorescent material of a precise and uniform thickness on the inside of the tube face, followed by a similar coat of aluminum in contact with the phosphor.

Giant automatic conveyors, designed by engineers at the plant, guide the tubes along slowly and smoothly to protect them against vibration.

Arriving opposite a tank, each tube has a feed pipe lowered to its neck. Automatically, a measured quantity of liquid is released which is a solution of demineralized water with phosphor powder suspended in it. It is easy to see that the slightest vibration would cause a ripple which would upset the smoothness and uniformity of the extremely thin phosphor layer.

On top of the phosphor a layer of nitro-cellulose is added which aids in depositing the aluminum layer. It is fed into the tube in the same way that the phosphor was deposited. Since the phosphor is in the process of quietly settling at the same time, the feed pipe terminates in a fine needle which projects about ¼ inch. Operating an electrostatic control which stops it from going down into the liquid, the needle releases the charge of nitro-cellulose without a tremor. Having played its part in assisting the aluminizing, the deposit of nitro-cellulose disappears. Then, like the bucket train of a dredger, the tubes move through a 180 deg arc and empty their water content. The phosphor used in these operations is so sensitive to metallic impurities that the labs where the phosphor is mixed are as sterile as a hospital operating theatre.

How does one go about depositing the microscopically thin film of aluminum (it is 5 millionths of a centimetre thick) on the face of the bulb and tube? Needless to say it is a delicate and refined operation for the film acts as a mirror to the light on the screen made by the

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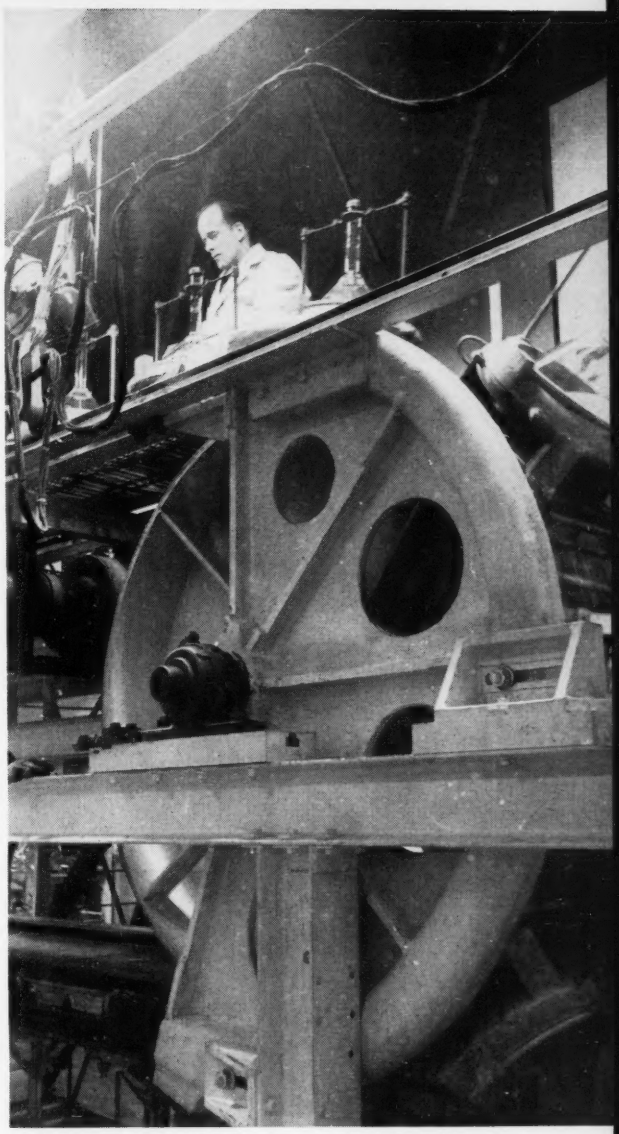
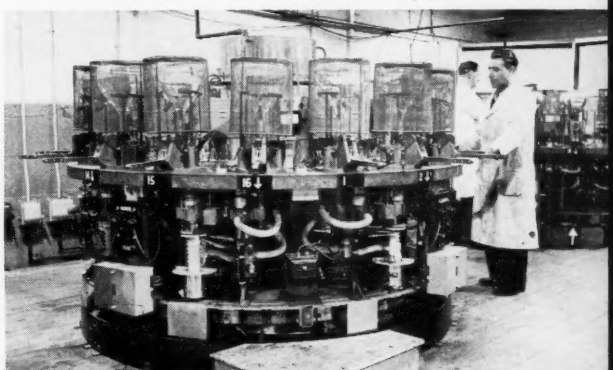
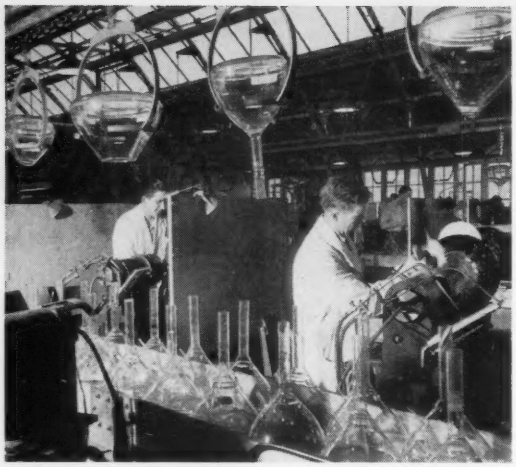


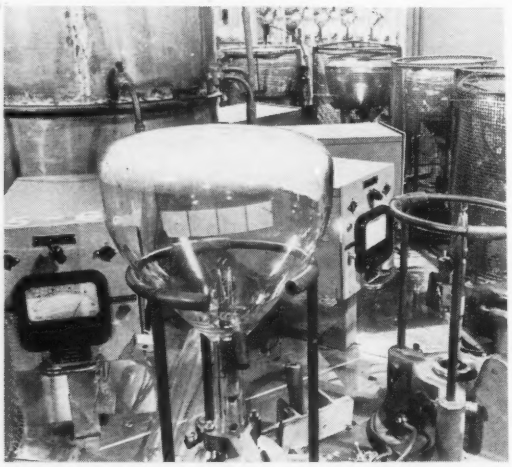
Delicate operation in tube manufacture is settling the fluorescent screen on face with huge automatic conveyor.



Another view of the top of one of the E.M.I. automatic screen settling conveyors at the plant in Middlesex.



Skilled glass workers fuse the parts that comprise the tube envelope on these specially designed fusing lathes.



Filament in rotary aluminizer carries aluminum pellet which evaporates under vacuum in tube to produce film.

Cathode ray tubes *(Continued)*

impact of the electrons from the electron gun. Reflecting the light forward towards the viewer, the brightness is increased since none of the light escapes back into the tube. The aluminum film also prevents the screen from being ion burned by ions that are present in the tube.

Placed neck downward on a circular conveyor the aluminizing process begins as the tubes have the air evacuated to form a vacuum. A small hairpin of aluminum wire is then enclosed in a spiral of tungsten wire fixed to a pair of contacts at the top of a rod which slides up the neck. At the critical moment the aluminum is vaporized by a heavy current passed through the spiral of tungsten. Slowly withdrawn at the same time, the aluminum film is deposited over the whole of the inside of the tube and down the neck.

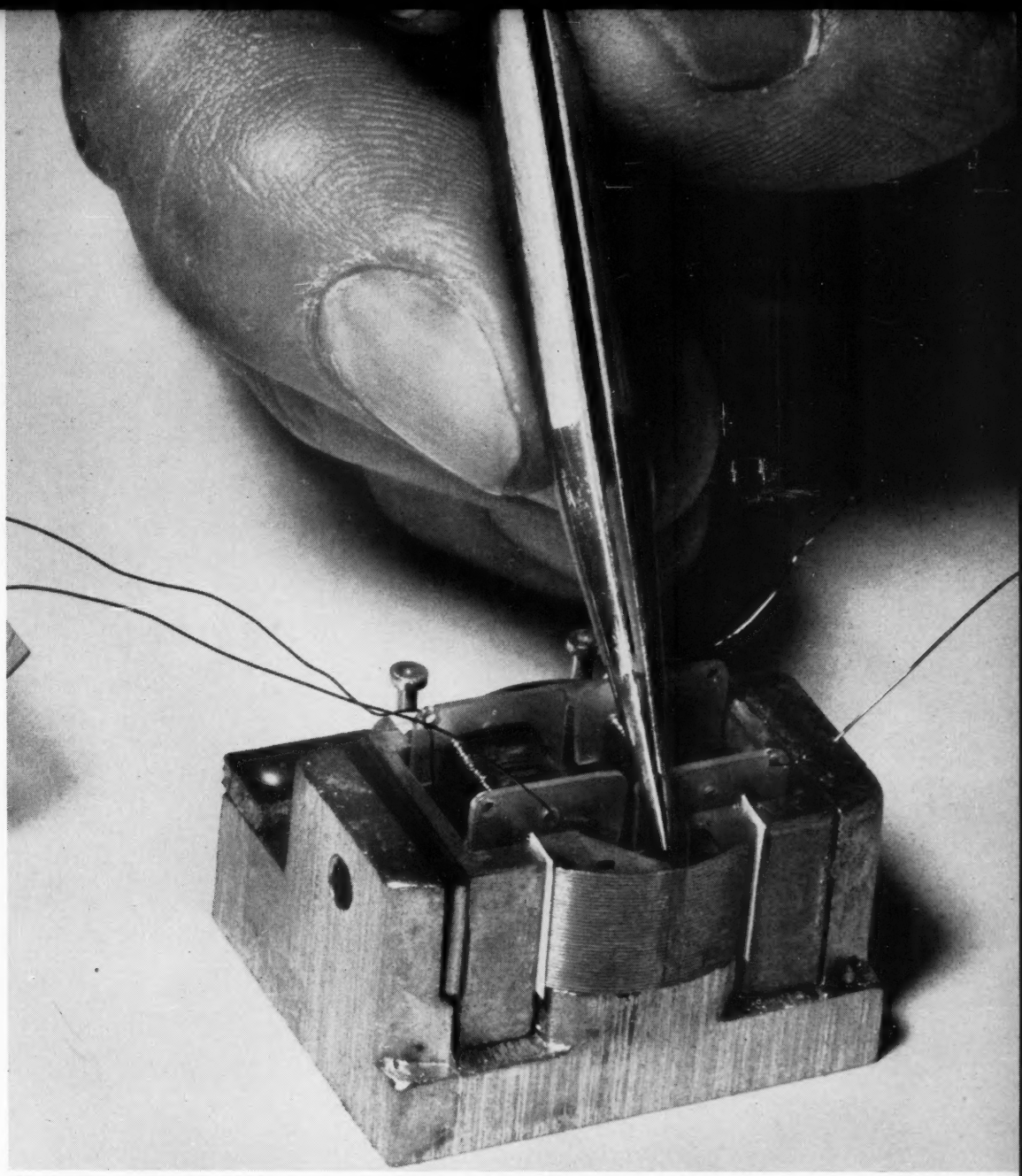
Now, the gun and the tube are ready for assembly. By this stage the gun has been mounted in glass foot which carries the contact pins. Made of a special alloy known as Kovar which gives the best glass-to-metal bond, the pins have a perfect leak-proof seal. The glass foot is then welded to the neck of the tube.

Final steps in the manufacture come as the tubes are mounted on one of a series of units which consist of a vacuum pump, power supply and an instrument and control panel. Pumped to a high degree of vacuum, the tubes are given a rigorous baking by eddy current heating to get rid of any possible unwanted gases that have developed. The "pip" of the tube is then sealed off by a getter of pure barium which guards against the most minute particles of gases being left free in the tube. Traveling around an oval-shaped track the tubes are "aged" and put through a series of tests to ensure their high quality.

Stored for a month at least, the tubes are then tested and checked again.

The amazing automatic plant at Hayes is an example of the ceaseless research that is going into the design of new tubes and the improvement of existing ones in an industry that is a U. K. pride. ★

Finished cathode ray tubes are aged, tested, on automatic device consisting of 55 self-contained test cabinets. Stored for a minimum of four weeks, tubes are once again thoroughly re-tested to ensure adequate shelf-life.



As the tape passes a .00025 in. gap it is magnetized according to strength and characteristic of signal.

Magnetic Recorders Memorize, Repeat

By RALPH E. ENDERSBY
TORONTO MGR. AMPEX AMERICAN

Versatile, they will tape facts or data, electrically convertible, and feed them to instruments, machines, in industry

IN LESS THAN 10 YEARS, magnetic tape recording devices have emerged from the experimental laboratory. They have grown into equipment which can reproduce not only the ultimate in sound but perform such feats as the accurate reporting of data from test flights of guided missiles.

A tape recorder theoretically is a simple device. It consists of a set of electro-magnets, known as heads; a mechanism for moving magnetic tape past the heads, known as tape transport; **(Continued overpage)**

and electronic amplifiers to convert the output of microphones into a strength enough to power speakers.

There are three heads in a set: erase, record, and playback. In recording, the erase head cleans any old recording from the tape. The record head puts a new signal on the tape by magnetizing the active material coated in the plastic tape surface. In play-back, the magnetic pattern on the tape coating induces a current in the playback head.

Design and construction of these heads is extremely critical. Their surfaces are lapped to finishes so smooth that variations are measured in wave lengths of light. The entire magnetic action takes place in the air gap between the two pole pieces of the head. For uniform performance throughout the life of a head, the air gap must remain of constant width despite wear from the tape, which is more or less abrasive. In playback heads, the gap is 0.00025 inches. This gives an indication of the precision required in building the heads.

The tape transport mechanism must be precisely assembled, too. Motion of the tape past the heads has to be absolutely uniform. Otherwise unwanted frequencies, known as "flutter" and "wow" will be introduced into the recording producing the same effect as a warped phonograph record.

The electronic amplifier must not introduce unwanted noise in the form of hiss or hum into the recorder. Reproduction must be so accurate that recorded sounds are perfect duplicates of the original sounds.

In February of 1948, the first Audio Tape Recorders were built by Ampex for Bing Crosby. These units are still in continuous use, and the specifications have never been excelled by the company.

Soon after the first Ampex sound recorders were put into use, it appeared that, if the frequency range of the machines were extended, they could be used for recording many types of information other than sound. From this concept has grown what is known as "instrumentation equipment."

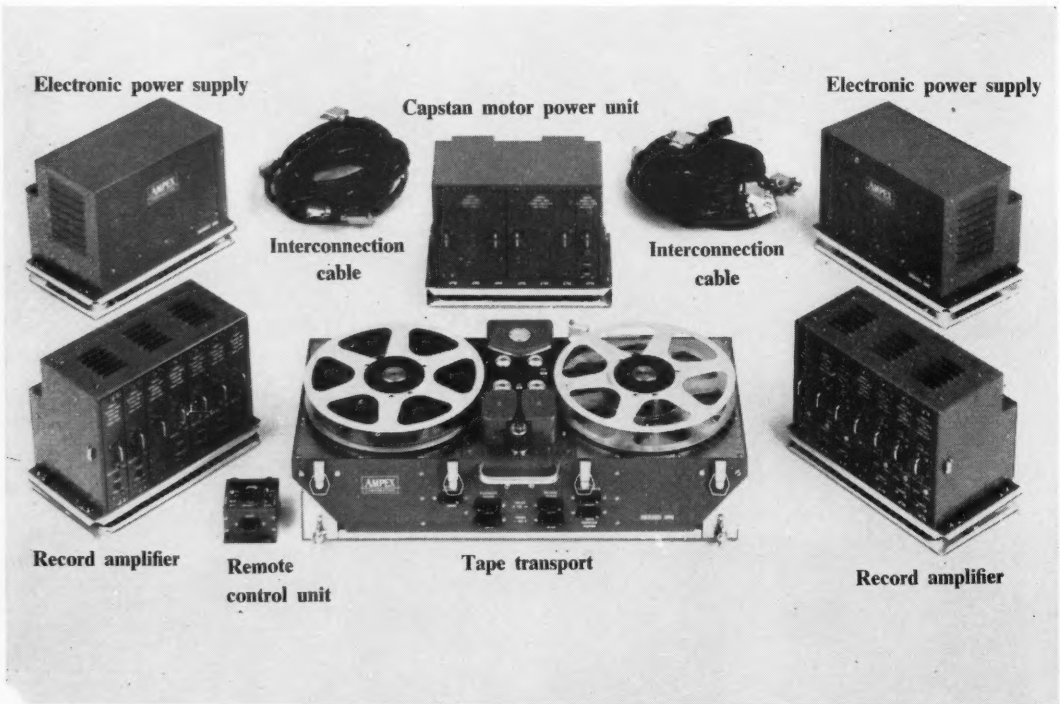
Sound recorders must handle frequencies roughly between 30 and 15,000 cycles per sound. By extending the lower end of the spectrum to 0 cycles (DC) many additional types of information, such as the mechanical vibrations of heavy machinery and the shock waves encountered in geophysical exploration, are handled. Extension of the upper end of the spectrum to 100,000 cycles per second, or higher, records other information such as that encountered in automatic relaying by radio from experimental aircraft.

These studies have resulted in equipment that can record information from DC to 100,000 cycles, and of record information in pulse width form.

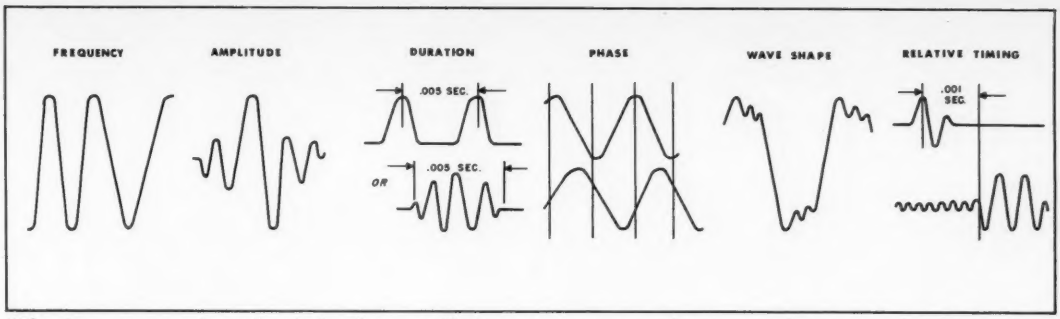
Development of magnetic recording equipment has many advantages over other forms of recording.

Tape recorded information can be fed to any instrument or machine that reacts to electrical signals. It plays back like the re-run of the original, because it gives back the same precise electrical signals it received. The signals are live and can do anything that the original data signals could have done, but with these important differences: The tape can be replayed in any place, any number of times, and in any number of ways.

Recorded information can be fed to instruments that scan, such as oscilloscopes and galvanometers, if the original data signals themselves allowed monitoring. But even if not, oscilloscopes can often be used on taped data by clipping or copying a short length of the



Airborne recorder, units shown, used to get electrically coded flight test data, has several mobile uses.



Vibrations, converted to electrical voltage oscillations; temperature and pressure changes translated to scale of voltage amplitudes; numbers becoming a sequence of electrical pulses, inform and command the magnetic tape.

Tape scanner examines irregularity in data, reproducing segment continuously

tape and running, inflection points, low points, specified values or particular correlations between parallel data channels, specialized scanning devices can take advantage of the electrical nature of magnetic taped data.

One of the latest devices using this type of equipment is the tape scanner, developed in co-operation with the U. S. Army Aberdeen Proving Ground. Used to examine a short section of recorded data where there is an irregularity, the tape scanner is designed for analysis of transient data stored on magnetic tape. A small segment of the tape is moved rapidly in a shuttling motion across the magnetic head assembly so it can be scanned repeatedly at high speed in overlapping scans. Thus, a single segment of tape can be reproduced continuously, allowing analysis of the data as it repeats. Since the scanning speed is independent of the reel-to-reel motion, the economy of slow-speed playback is combined with the wide frequency range of high-speed playback.

Formerly, an attempt to analyze this type of information was made graphically or by actually "scissoring-out" a segment of the tape with the data in question. It was then spliced into an endless loop on a specially designed loop reproducer. Ampex's tape scanner uses a mechanism which oscillates the tape over standard fixed playback heads, rather than attempting a system which oscillates or rotates the head, which causes head and tape alignment problems.

Recorded information also can be fed to instruments that write. Selected portions of taped data can be played onto an oscillograph many times, each making a different visual record and revealing more information. Scales can be expanded or contracted in either a lateral or a longitudinal direction. Channels can be transposed, higher frequencies on tape can be brought within range of oscillographs, or even pen recorders, by slowing down the tape playback, and data can be filtered in various ways with tape speed-up, if necessary.

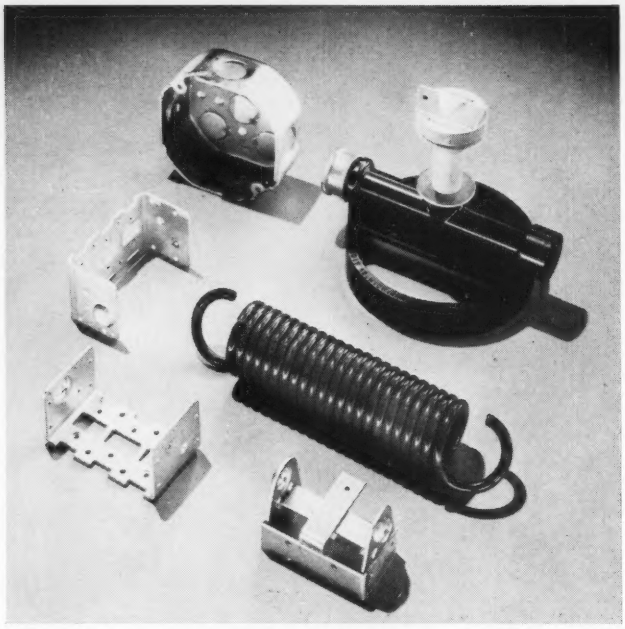
Recorded information can be fed to machines that analyze, such as computers and automatic data reducers. In elaborate testing and computation programs, many manhours can be saved by recording the data on magnetic tape in a coded electrical form that can be fed directly to computing devices. In this way, computed and correlated test results may be obtained with a minimum of intermediate handling and reduction of recorded data. And tape can be an input medium as fast as the computer itself, saving time. For recorded data that are below the level of accompanying noise, tape can be used with special correlation techniques that cancel out the noise and reveal the desired information.

A new application developed by the company in this field is an airborne magnetic tape recorder especially designed to get flight test data. This equipment has a mobile application in trucks, tanks and other vehicles where the recording of instrumentation data is desired. Known as Series 800 equipment, the light-weight, shock-resistant recorders are available in versions ranging from units designed to record two channels of information on ¼-in. tape to models intended for recording 28 tracks on 2-in. tape.

Plug-in amplifiers permit recording on any track of pulse-width modulations data, high accuracy transient information by means of wide-deviation frequency modulation or wide band direct data, including mixed RDB/EM/FM subcarriers. These various recording techniques can be used in any combination.

Material recorded on **(Continued on page 62)**

Recorder above is used in radio, TV, film industry, providing high order fidelity for commercial use.



Olive drab treatment was given spring, centre, assembly, upper right, later dyed black. Remainder have metallic bright finish.

Chromate Treatment Is Anti-Corrosive

And it improves appearance of such metals as zinc, cadmium and copper

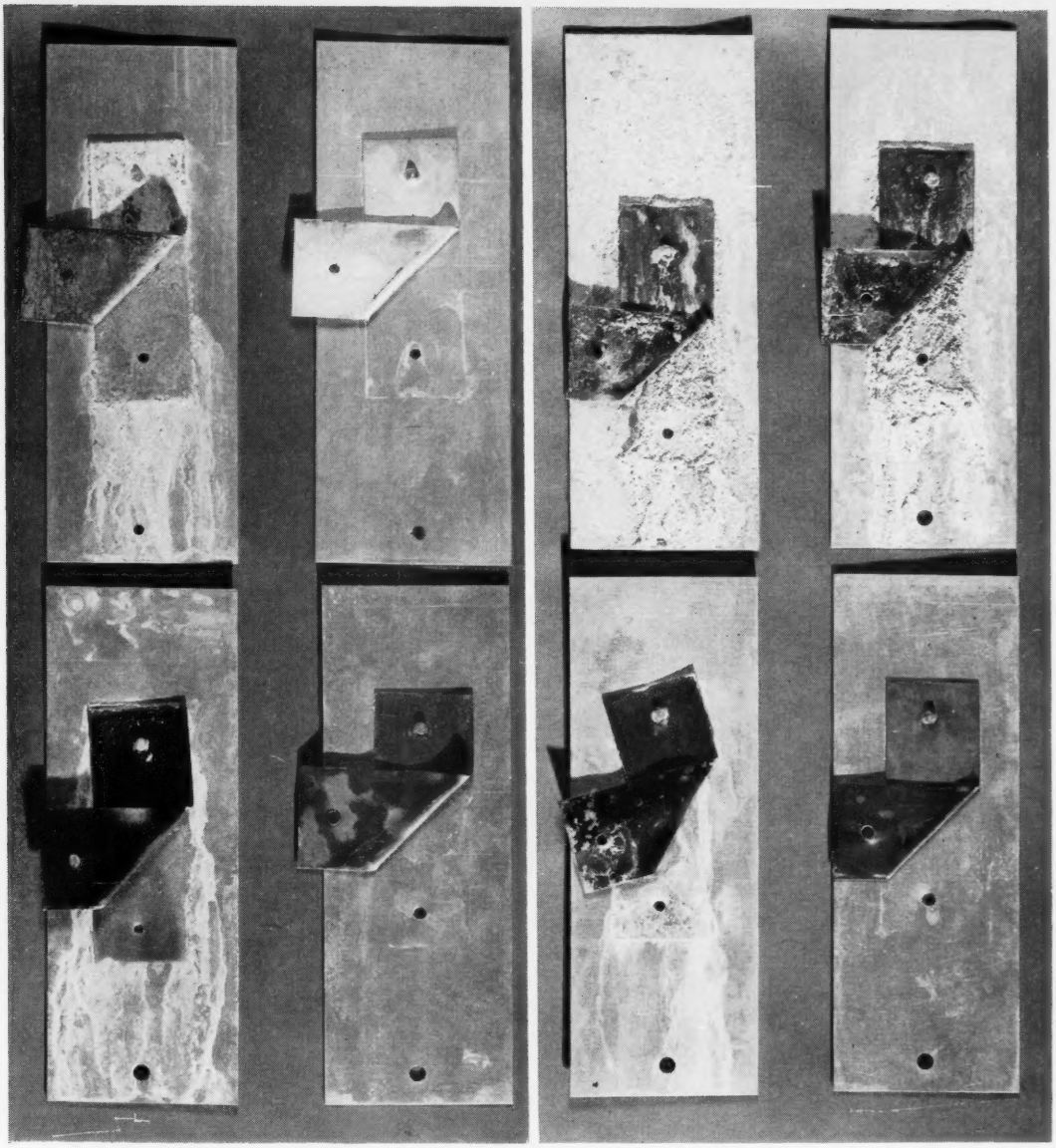
By WALTER E. POCOCK
ALLIED RESEARCH PRODUCTS

PROTECTIVE CHROMATE CONVERSION treatments fall into the group of chemical surface treatments that (a) are of such value in the metal finishing industry that they cannot be done without, and (b) a group that are being used increasingly, applied to zinc, cadmium, aluminum, magnesium, and cupreous alloys either as a final finish or a base for paint. Earlier chromates were applied mainly as treatments for zinc and cadmium, but their use in recent years has been more common in treatments for magnesium and aluminum. Chromate treatments are being applied more and more to copper and its alloys.

The reason for the popularity of chromates has been their ability to protect certain metals against corrosion, particularly corrosion due to moisture and humid atmospheres. It can cope with corrosion problems, from simple tarnishing to the formation of white rust on zinc, and the white corrosion and pitting of aluminum and magnesium. Not only do the chromates protect, they also improve the appearance of the metal surface because of the metallic bright or colored finishes they provide. For paint and other organic finishes, chromates make an excellent base.

All chromate conversion treatments use chromic acid or one of its soluble salts, which contain chromium in the hexavalent state. Water solutions of hexavalent chromium compounds alone do not react to any appreciable extent with the metals involved in this discussion. However, a reaction can be brought about by the addition of other chemicals which serve as activators. If the clean metal surface is immersed in such a solution, properly formulated, a thin film, or conversion coating, is produced. This film has the desirable characteristic of retarding corrosion of the metal surface. The term "conversion coating" denotes that the surface metal is converted into a non-metallic form in the film-producing reaction. Coatings vary greatly both in appearance and protective value. A variety of coatings is obtainable with each metal, but the range of coatings possible differs from one metal to another. In order to clarify this picture the various metals subject to chromating are classified in groups, below, and the types of coating obtainable with each group are shown. The colors indicated are of the coatings as formed. Appearance can in many cases be modified by further treatment.

- Group I—Zinc and Cadmium: Metallic bright, light iridescent, iridescent yellow, bronze, olive drab, black.
- Group II—Copper, Brass, Bronze: Metallic bright, yellow.
- Group III—Aluminum Alloys: Clear, iridescent yellow, brown.
- Group IV—Magnesium Alloys: Metallic bright,



Galvanic corrosion on treated, untreated aluminum

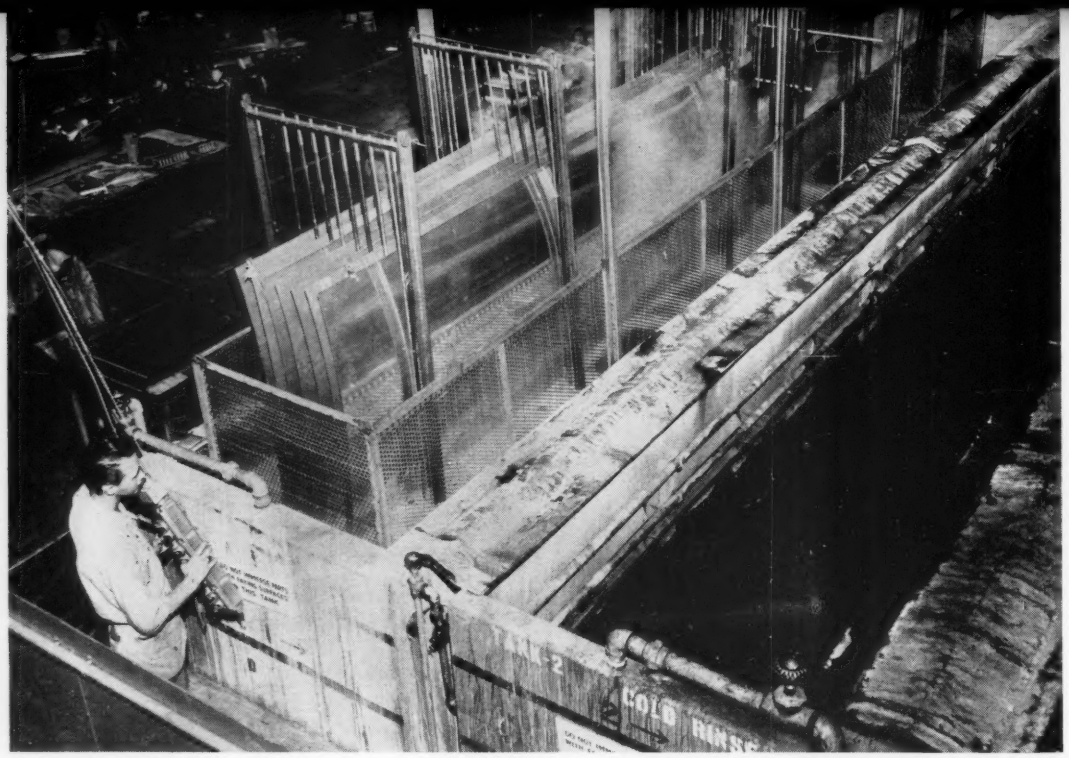
Unprotected aluminum on copper, second from left top row is compared with protected aluminum in contact with various cathodic metals. Note the corrosion set up by the galvanic attack on metal.

—iridescent yellow-red, brown and black color effects.

A detailed discussion of the treatment applied to these groups is given later.

Chromate baths for coating magnesium were known in 1924. Brass-colored, brown, and black films were obtained from acidified solutions of sodium dichromate, with or without the addition of certain metal salts. A number of other chromate treatments for magnesium, zinc, cadmium, and copper alloys came out between 1924 and 1936. One that found wide application was a bright dip for cadmium. The most important of the early developments was a dichromate-sulfuric acid process, patented in 1936. In this treatment light iridescent, yellow, and bronze-colored coatings are obtained on zinc and cadmium. A subsequent development was solutions of chromic acid and sulfates, followed by dilute acids or alkalies, to obtain a metallic bright finish. During World War II a process was introduced for producing, on zinc and cadmium, olive-drab-colored coatings, having greater corrosion resistance than the previously obtained light iridescent to bronze films. Besides the olive drab color, black and other colors can be obtained by dyeing the olive drab coating. Another development was an electrolytic chromate treatment for zinc. Many of the proprietary treatments for zinc and cadmium in use at present are improved versions of the original dichromate-sulfuric acid process.

Chromates on copper and its alloys, have evolved



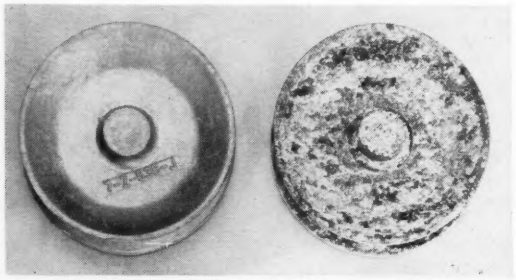
Basket is lowered into alkaline cleaner tank. Note koroseal on stainless steel rods to protect aluminum.

Chromate Treatments *(continued)*

mainly as chemical polishing bright dips providing some degree of passivity. Heavier, more protective films are now available where appearance is of relatively little consequence.

The development of protective finishes for magnesium has been carried out largely by the magnesium producers themselves. A large number of treatments have been devised over the past thirty years. Relatively few of these have survived in commercial use, except those of the chromate type.

Chromate treatments for aluminum have gained prominence in recent years and in general, are a decided improvement over earlier chemical treatments. Two of the earlier processes use hexavalent chromium compounds, although neither can be classified strictly as a chromate treatment. One is an alkaline process producing grey aluminum oxide coatings which are subsequently "sealed" in a potassium dichromate solution.



Aluminum sand casting left, treated. Right, after 120 hours salt spray without chromate treatment.

The other, a proprietary process which in its essence uses chromic as well as phosphoric acid, gives a light green phosphate-type coating. The first true chromate conversion treatment for aluminum was introduced in 1950. The high degree of corrosion protection and the simplicity of operation have led to its wide usage. Several similar treatments have appeared more recently.

Most chromate treatments at present, except those for magnesium, are of the proprietary type. Users are supplied with powdered compounds or liquid concentrates, from which working solutions are made up and operated according to manufacturers' recommendations. A variety of formulations, tailored to meet specific requirements, are available. Although different proprietary treatments are similar in operation and results obtained, no two are exactly interchangeable. The present discussion proposes to cover the important principles involved in chromating, and is not concerned with detailed differences between individual proprietary treatments.

Extreme simplicity of operation is one of the attractive features of most chromate treatments. The chromating step itself is usually only a simple immersion in the chromate solution. Processing times, including cleaning, are short. Although there are one or two electrolytic chromate treatments, electrical power is usually not required. Since there are no fumes in most cases, ventilation is not necessary. The essential items of equipment are rinse tanks, an acid resistant container for the chromate solution, and baskets, racks or hooks for handling the work. Acid resistant materials commonly used include stoneware, stainless steel (where solutions do not contain hydrochloric acid or chlorides) and acid-resistant plastic. Most chromate solutions operate at, or near room temperature. Although a certain amount of temperature control is necessary, this is never extremely critical. Provisions for moderate heating during cold weather is very desirable, but not always necessary.

Constant efforts are being made to simplify the

chromating of metals. For example, in the case of magnesium, the most effective chromate processes until recently have been cumbersome and slow. Now, by a new proprietary treatment, highly-protective chromate films can be produced by a simple room-temperature process in a matter of seconds.

The flexibility of chromate formulations permits it to be used for a variety of operating conditions. For example, in the chromating of plated work in automatic machines, formulations can be modified to fit predetermined time cycles. For the automatic processing of work that is not plated, chromate formulations have been adapted to existing automatic equipment. Chromates have also been adapted to spraying and in most cases can be applied simply by brushing or swabbing the metal surface.

The steps involved in a typical chromating dipping process are as follows:

a. Pretreat;
b. Rinse;
c. Chromate;
d. Rinse;
e. Bleach or dye (optional);
f. Rinse; and
g. Dry.

Proper pretreatment, step "a," is quite important, the object being to provide a properly cleaned surface. Chromate treatments have little or no value as cleaners in themselves. Pretreatment of nonplated articles consists of first removing oil, grease and other lightly adhering oil and leaving the surface in a completely wetted condition. If the metal contains surface oxides as well, an acid dip or pickle of some kind is generally used to remove these oxides and generally activate the surface. In the case of plated work, the freshly plated metal can be directly chromated, after rinsing, without further treatment, although a dilute acid dip is sometimes used as a neutralizer prior to chromating, where residual alkaline plating solution may be excessive.

As with any other finishing process, thorough rinsing is highly important throughout the cleaning and treating cycle. A final hot rinse can be used as an aid to drying, subject to limitations imposed by individual treatments. Drying is carried out by conventional methods, such as air blasting, centrifuging, or circulating warm air. Handling at this point must be done with care, since films are soft and subject to abrasion until completely dried. Overheating in the drying step is undesirable, as this results in a lowering of corrosion resistance.

Bleaching or dyeing (e) is used in some cases to modify the appearance by removing or adding color.

The chromate bath is essentially an acidic water solution of a soluble hexavalent chromium compound plus one or more activators. Specific formulations will not be discussed here, but certain general principles will be outlined which apply generally to chromate solutions.

Hexavalent chromium compounds are recognizable by their yellow, orange or red color. Compounds most commonly used are chromic anhydride (chromic acid), sodium dichromate and potassium dichromate. Activators vary according to the treatment, and include both inorganic and organic chemicals.

Besides hexavalent chromium compounds and activators, the bath may contain other substances which serve to modify the appearance of the coating or the operation of the solution. Such additives do not appear to critically affect the chemical balance of the bath.

Little is known about the composition and structure of chromate films. A few generalizations can be made, however. It is fairly well established that most films are gel-like rather than crystalline. Films are soft and absorptive while freshly formed and still wet. On drying, they "set" or harden, and become rather nonwettable and impervious to aqueous solutions. The hardening process appears to continue, at a slow rate, for some time after drying. Yellow films owe their color to soluble hexavalent chromium compounds. These soluble compounds can be leached out by subjecting the freshly formed coating to dilute solutions of acids or alkalies. An insoluble film, which may or may not be visible, remains. Water alone has this same leaching action, but at a much slower rate. Leaching is accelerated by increasing temperature. Prolonged acid or alkaline leaching will result in eventual removal of the insoluble as well as the soluble portion of the film.

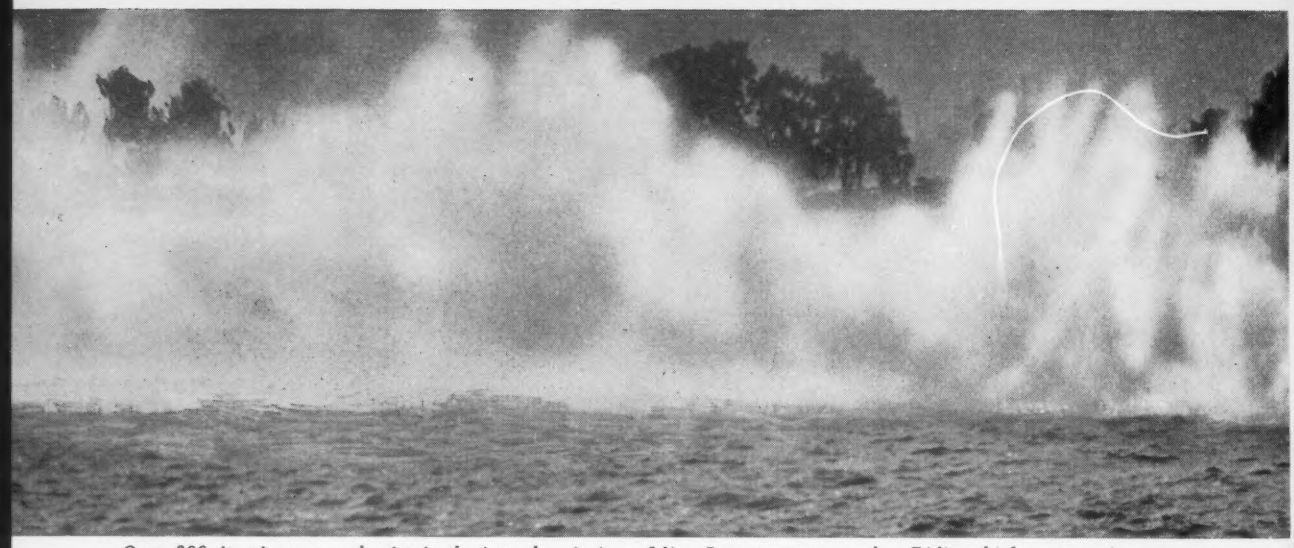
In considering chromates as bases for organic finishes, two factors are important. First is the improvement of initial adhesion of organic coating to metal. Some surface treatments do this through a "tooth" effect, i.e. mechanical interlocking with undercut pits in the metal or with the rough surface of the chemical coating. Chromate coatings, on the other hand, are believed to provide bonding through molecular adhesion. The chromate film is bound to the metal surface by molecular attraction and, in turn, holds the organic film by the same mechanism. The second factor is extending the life of the organic coating. In this, chromate films have an advantage over other paint-base coatings which do not in themselves have a corrosion-inhibiting effect. The chromate film forms an effective barrier against either corrosive attack through pores or scratches in the organic coating, or a reaction between the metal and the organic coating itself. A further advantage of chromates is that, since films are thin and nonporous, there is little or no absorption of paint or other applied organic material, this affording more economical use of the organic coating as compared with certain crystalline-type paint-base coatings.

Gel-like films, soft, absorptive while wet, become impervious, hard

The greatest variety of chromate treatments, and by far the largest number of proprietary products, are to be found in group I—treatments for zinc and cadmium. Treatments are applied to electroplated zinc and cadmium, die cast zinc, and galvanized iron.

Let us consider first the effect of chromate films on plated metal. Zinc and cadmium, when plated over steel, protect against rust formation through sacrificial galvanic action. The plated layer, being electropositive to steel, is corroded, while the steel is rendered passive. In this process, the plated metal tends to corrode faster than it would if it were not in contact with the steel. When a chromate film is applied, it serves a dual purpose. First, it retards initial corrosion of the plated layer. Eventually, the protective film will be broken through and the plate will begin to corrode. Even after this has started, however, the remaining chromate film continues to exert its inhibiting action, and thus retards eventual rusting of the base steel. In cases of other than plated metal there is, naturally, no such dual effect.

Chromates are being practically applied to as little as 0.00002 inch of zinc plating, although a minimum of 0.0002 inch is desirable. Above this thickness, an apparent decrease in plate porosity greatly increases the effectiveness of the chromate treatment to prevent first signs of any corrosion. **(Continued on page 58)**



Over 300 ft. of spray and mist froths into the air from Miss Supertest at speed. Riding high onto twin sponsons

Was it just bad luck that kept the world record from Canada?

Canada's fastest boat is little known. But it may beat the world in 1956

By ALEXANDER BARRIE
MANAGING EDITOR

ON THE LAST DAY of October, as a six-inch chop ruffled the surface of Lake Ontario's Picton Reach, a Canadian built boat streaked twice over a measured mile. Officially, Miss Supertest II was out for a new Canadian speed record; and unofficially it was hoped she might prove herself the fastest propeller driven boat in the world.

In practice, she had crossed the reach at speeds of between 170 and 175 mph. Then for the record breaking run, six stop watches of the Canadian Boating Federation gave her the lower averaged speed of 154.854. It was comfortably good enough to take the six-year-old Canadian record of 138 mph held by Harold Wilson with Miss Canada IV away from him. But it was well short of beating the world. So, to most people involved, the run was an official success and a private disappointment.

A decision was made to try again at once. Then a mysterious knock started deep in the engine. The experts gathered round, decided a rod had been thrown; after more listening and looking they changed their minds. It had become clear that whatever else might have happened, all rods were in place. At last the baffled* experts made the only possible decision and Miss Supertest was hauled from the water.

A second mystery was then discovered. The record attempt had been made with a jagged underwater hole in the boat's port sponson.

Although a collision with some floating object had taken place, either while running to the start or immediately after beginning the mile, the driver knew nothing about it. Forty year old Hamiltonian and speed-boat expert W. G. (Bill) Braden had held the wheel at the time. He was amazed. "Not only was the sponson damaged," he explained, "but a stabilizing fin had gone. Yet she handled perfectly! It's pretty wonderful." The dihedral of the sponsons had ably taken over the work of keeping her stable.

So Miss Supertest had just had a bit of bad luck. With a crude hole scooping at the water, a fin gone and the "air trap" of the hull impaired, she had come to within 24 mph of the world record†. Suddenly it had become a performance to acclaim.

The boat will be in the water again this year; but not for serious work. The coming of winter means at least a five-month wait before high speed trials can

*At the time this article went to press the experts were still baffled. The engine is being shipped to Rolls Royce for checking.

†Miss Supertest will not have to beat the November 16 Bluebird record of 216 mph since jet boats are classed separately.

she can cross choppy water at a spectacular 150-170 mph.

resume. Meanwhile, two full-time mechanics will toil through the long off-season to make sure that Miss Supertest II is on perfect form for her next public appearance.

Behind this very costly project stand two men—father and son. Gordon Thompson, chairman of the Supertest Corporation, produces the money while son, James, sees that it is wisely used. Neither will discuss costs. "I don't know what we've spent," says the younger Thompson, a speed boat enthusiast of long standing. "And if I did I wouldn't say. The cost is entirely our business."

Newspapers, anxious for some sort of figure to quote made a guess at a quarter of a million dollars—described by James Thompson as "nowhere near right."

Precise figures are not needed to show that this 31 ft. boat weighing 7,200 lbs. and powered by a 2,500 hp Rolls Royce Griffon has been an expensive project.

She was built to the design of Leslie Staudacher by MacCraft Industries Ltd., Sarnia. No one denies that there is much about her which resembles the American (Seattle) world beating boat Slo Mo Shun IV. But she is bigger—31 ft. against 28—and higher powered.

The Miss Canada boats and other older ones, were built as "displacement hydroplanes" with stepped hulls. Miss Supertest, like Slo Mo Shun, is a "three pointer." At speed she rides only on the rear tips of the sponsons and the propeller.

Design work on the hull of a super-high-speed boat is exacting. As the speed builds up and the craft rides out of the water, the forward shape of the deck and lower part of the hull must be in perfect aerodynamic balance. The slightest mistake in the contours will either drive the boat hard down below the surface or else convert it into a aircraft. A reminder of just how critical this shaping is came a few weeks ago from the newest Seattle boat, Slo Mo Shun V. In the hands of Lon Fageol, while out practicing, she wound up to about 150 mph, then met a sharp 20 mph breeze from ahead. Slo Mo Shun reacted at once by leaping from the water, climbing 30 ft. into the air and looping the loop. To spectators' surprise the driver survived. But the boat was hopelessly wrecked.

Miss Supertest races with her sponsons at a 3 deg angle of attack, pushed into the right attitude by the propeller. Bill Braden is sure the balanced slopes of her upper and lower halves keep her safe from any sudden aerobating up to a speed of 200.

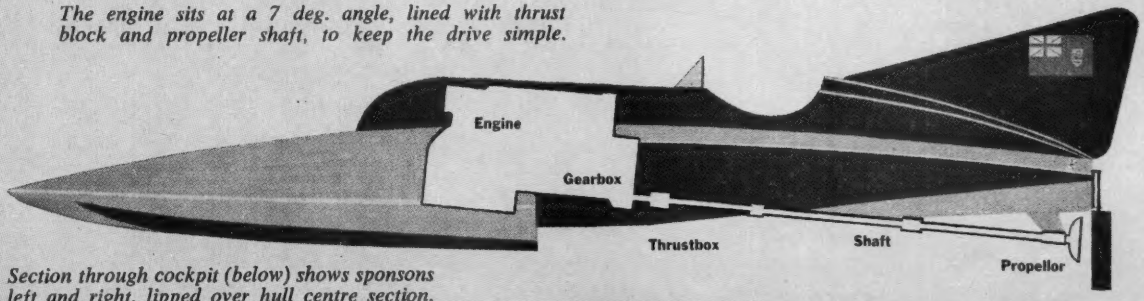
She is constructed from laminated frames of spruce and white oak carrying a sheet aluminum bottom, double laid diagonal ply sides and a mahogany-ply top deck.

To engineers not familiar with speed boat design,

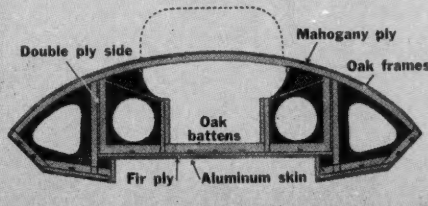
(Continued over page)

The balanced lines of Miss Supertest's hull keep her at a safe 3 deg. angle

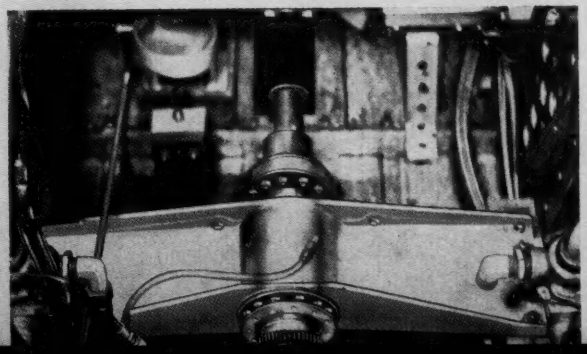
The engine sits at a 7 deg. angle, lined with thrust block and propeller shaft, to keep the drive simple.



Section through cockpit (below) shows sponsons left and right, lipped over hull centre section.



Creative design (right). Other boat builders ignore heavy push-pull thrusts on the engine. But Miss Supertest has built-in thrust block.



DESIGN ENGINEERING PICTURES

the pigmy sized propeller is a surprise. It measures 13½ in. from tip to tip and has only two blades. Yet it converts the huge power output of the Griffon into 170 mph-worth of forward thrust. It achieves this performance only half submerged with one blade driving at a time. To do so, it flogs the water at a cruel 9,500 rpm. Serious propeller stress cannot be avoided.

For years, bronze was used. In the search for greater strength to handle the Griffon's horsepower, Miss Supertest was given a steel forged propeller—a newish design technique. But even forged steel will only take so much. James Thompson believes that propeller metallurgy has become the speed limit factor in boat design.

The Griffon is mounted in line with the long drive shaft which rakes through the boat's hull at a 7 deg angle. It burns a mixture of aviation spirit and methanol (with water injection) at the rate of two gallons a mile. The motor delivers its power to a home designed and built gear box set in a cast aluminum housing bolted to the rear of the engine block. Here a 3.65 to 1 increase ratio steps up the leisurely revolutions of the aero engine to the furious rpm the propeller requires.

For months, James Thompson discussed the gear assembly with Hamilton steel foundry man Bruce Wells. Then the foundry went to work. From its quaintly old-fashioned shop came a one-off, single ratio box of two heavy-filleted, full depth, corrected, toothed gears carried in pressure lubricated bearings. Because a light-weight aluminum housing was also chosen, steel retainers had to be shrunk into the casting to carry the bearings.

A unique feature of this all-Canadian gear box is that for the first time in speed boat design, it is relieved (in theory at least) of all thrust. A separate thrust block was designed and made to sit aft of the box to deal with both forward and backward thrusts. It is, as the designers themselves confess, a slightly crude piece of engineering.

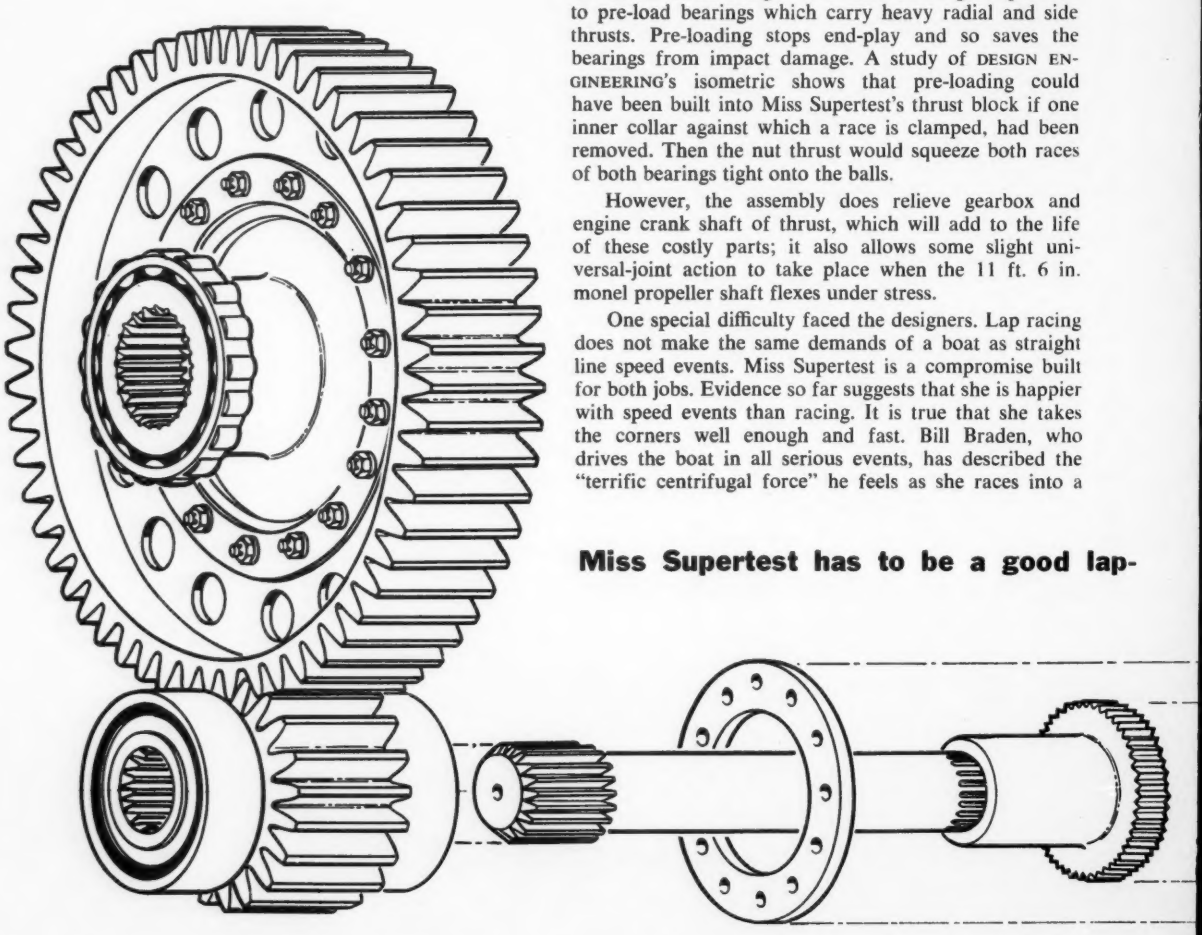
The short length of shaft inside the thrust block is threaded at both ends; pull or push thrust is transmitted from the shaft to ball bearings by means of two nuts—one screwed to each end of the shaft. The method works. But James Thompson admits that he does not like using nuts to handle thrust. "We might think of something better someday," he says.

This is not the only criticism which can be made of the thrust block design. It is held to be good practice to pre-load bearings which carry heavy radial and side thrusts. Pre-loading stops end-play and so saves the bearings from impact damage. A study of DESIGN ENGINEERING's isometric shows that pre-loading could have been built into Miss Supertest's thrust block if one inner collar against which a race is clamped, had been removed. Then the nut thrust would squeeze both races of both bearings tight onto the balls.

However, the assembly does relieve gearbox and engine crank shaft of thrust, which will add to the life of these costly parts; it also allows some slight universal-joint action to take place when the 11 ft. 6 in. monel propeller shaft flexes under stress.

One special difficulty faced the designers. Lap racing does not make the same demands of a boat as straight line speed events. Miss Supertest is a compromise built for both jobs. Evidence so far suggests that she is happier with speed events than racing. It is true that she takes the corners well enough and fast. Bill Braden, who drives the boat in all serious events, has described the "terrific centrifugal force" he feels as she races into a

Miss Supertest has to be a good lap-



This (copyright) cut-away shows, at left, the 3.65 to 1 increase ratio gear assembly and short splined shaft leading to

In action, Miss Supertest looks less than her 7,200 lbs. But at rest, she sits low with both sponsons submerged.

turn; it would be strong enough, he says, to throw him overboard were he not hooked in. But she has still to win her first contest.

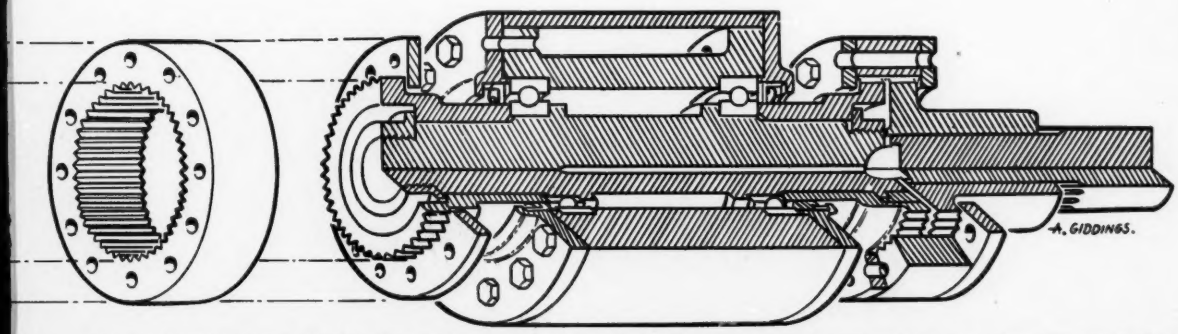
The best she has managed so far was second place at the Lake St. Clair race last July. Yet she has competed in most of the dozen or so big race meetings which take place annually within reasonable distance of London—her home base. On the other hand, it is only fair to remember that she is still new.

The two men with most to hope for from Miss Supertest II are wisely cautious with their predictions. They plan to compete again in the major races next season; they will make huge efforts to carry some of the bigger trophies home to Canada. But they are promising nothing.

Of their hopes for a world-beating mile, they have equally little to say. When DESIGN ENGINEERING pressed Bill Braden for an answer to the question, "will you try for the record next year?" he made this careful reply: "It's hard to say. But we might."

There seems little enough doubt that they will. And with an undamaged hull and the Griffon in good health, Miss Supertest's chances show promise. A new world record may well be Canada's in 1956. ★

racer as well as a straight miler. It is not easy to build a boat for both jobs



the two-bearing thrust block (above right). At each end of the block a gear and toothed ring joint gives fractional play.

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Quotes

Points from current papers and speeches

IT IS known that bolts can be strengthened by reducing the diameter of the shank to less than the outside diameter of the threads. What has not been known is how much reduction is required for optimum strength.

An answer to this question, for bolts subjected to tensile impact loads, was given at the Diamond Jubilee annual meeting of the American Society of Mechanical Engineers by **John Love and A. O. Pringle.**

They concluded that for maximum energy-absorption, the shank area of a steel bolt should approximate the mean or tensile-stress area of the threads, with minor corrections to compensate for work-hardening produced by thread rolling or surface oxidation resulting from heat treatment.

More specifically, it was determined that low-carbon ⅜-in. bolts with rolled threads absorbed maximum impact energy when the shank area was 1.23 times the thread-root area. It was found that heat-treated, medium-carbon ⅜-in. bolts absorbed maximum impact energy when the shank area was 1.12 times the thread-root area. When the shank area of these bolts is reduced by drilling, it should be 1.17 times the thread-root area. Tests were made on 5/16-, ⅜- and 7/16-in. bolts.

The authors pointed out that impact loads have a different effect from fatigue loads and that an increase in fatigue strength has been obtained by greater reductions in shank area. In tensile impact loads the transition from ductile to brittle-type fracture, which may be promoted by notches (threads), is one of the most important factors.

Results of experience in using better bolt proportions should lead to revised procedures for selecting bolt sizes and to greater economy in design.

• • •

TELEVISION as a communication tool was barely known at the beginning of 1955, despite TV's spectacular success as an entertainment and news medium. Today, however, the greatest advances in TV are being made in its application to industrial and educational problems. Closed-circuit television is unquestionably emerging as an electronic giant.

These remarks were made recently at the National Electronics Conference by **James L. Lahey,** general manager of Dage television division, Thompson Products, Inc.

He believes that closed circuit television is entering a period of boom marketing conditions, one which will see equipment demands and sales during 1956 alone surpass the $4 millions worth sold since the industry was born within the last decade.

Lahey said Dage alone, as one major producer in the industry, plans to install more than 1,500 cameras during 1956, thereby exceeding total installations of all manufacturers heretofore.

There are fantastic possibilities for closed circuit television. These can be more easily understood if the TV camera is regarded as an extension of human vision, able to perceive and transmit to viewers miles away or just next door, scenes and information that cannot otherwise be readily or safely viewed, as explained in **Design Engineering,** September (page 34).

Prominent among the new uses of TV are: remote reading of meters, gauges and other data in distant or hazardous locations; production control, process control; materials handling, and innumerable teaching activities at colleges and in industry.

Many of these new uses have been made possible by simplified circuits, developed to take full advantage of the stable characteristics of the vidicon tube. Recent engineering advances make TV uses possible where light levels are absurdly low.

• • •

AUTOMATIC DIPPING was the subject chosen by **Ralph Hanna** for his paper at the Shop Practice Forum of the Porcelain Enamel Institute.

The automatic dipping machine consists essentially of an endless parallel conveyor. At one end a 24-in. drive sprocket engages the chain and at the opposite end a 24-in. take-up sprocket completes the endless conveyor. The work-holder station centres are determined by the largest piece of ware to be dipped on the machine, and the standard drive consists of a 1½-hp motor, complete with magnetic starter and two push-button stations, a safety clutch, variable speel pulley and speed reducer with neccessary couplings. A structural steel frame is provided to carry the conveyor, drive and movement stations.

The development of the automatic dipping and draining machine accomplishes the same purposes as hand-dipping but is far superior because it increases production, improves quality, reduces manpower and the number of repeats and saves material.

• • •

AS THE result of a recently developed contour rolling process, titanium sheet A55 and A70 can now be supplied with improved stiffness, states an article in the **Rem-Cru Titanium Review.**

Use of alloyed titanium sheet in applications where high temperatures preclude the use of aluminum alloys, and where stainless steel would result in a severe weight penalty, has led to important weight savings in both military and civil aircraft. Now in many applications A55 and A70 sheet supplied in a three-dimensional pattern can offer additional weight savings.

Light metals offer high strength but neither mechanical working, heat treatment, nor alloying can make any great improvement in the modulus of elasticity. Since many applications require stiffness as well as strength, any improvement in stiffness of titanium is important to the designer. Many different patterns of design-strengthened sheet and strip in stainless and aluminum for decorative, functional and structural purposes can be obtained.

Now, since titanium sheet can be contour-rolled to higher rigidity, in many applications where the weight savings of titanium appeared to be marginal due to lower stiffness, A55 or A70 in design-strengthened sheet offers savings.

• • •

IN A paper read at the Fall Meeting of the American Welding Society, details were given by **Gordon S. Wepfer** concerning the development of high tensile, high impact electrodes.

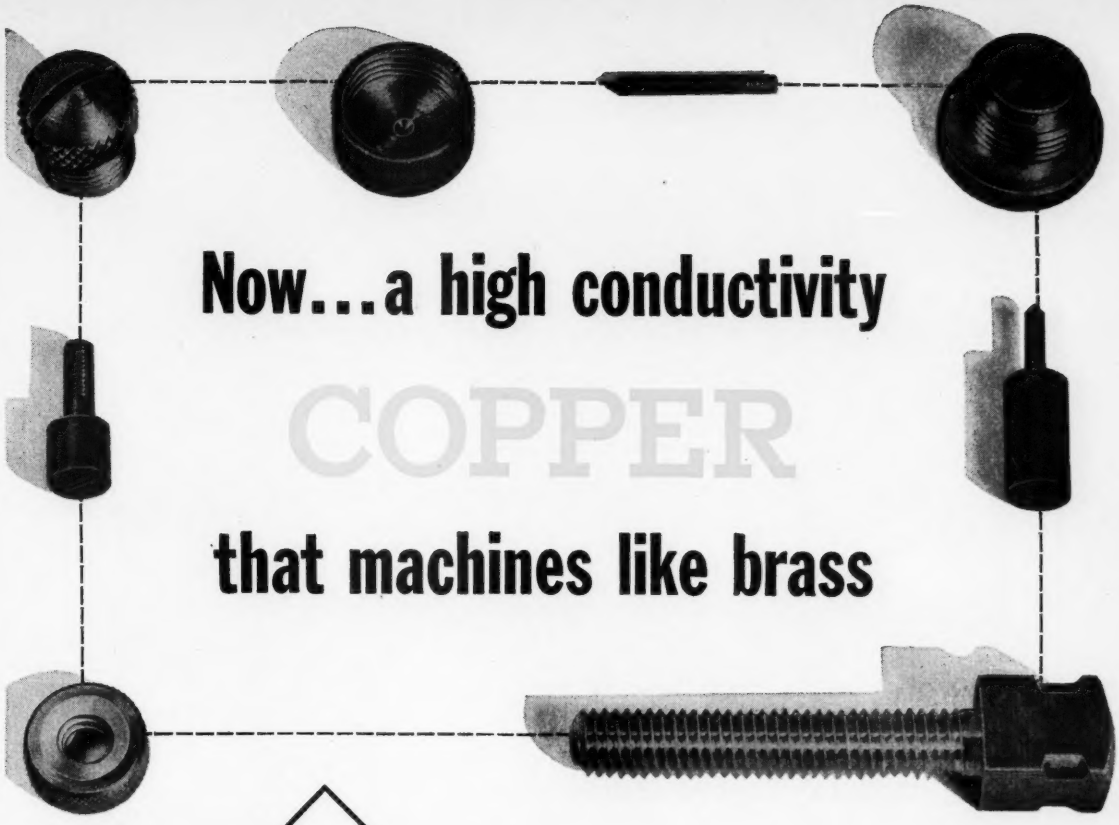
The recent development of low alloy, high tensile steels, such as Carilloy T-1 steel, and the continued demand for satisfactory electrodes for the welding of armor plate, led to the following investigation.

Available E120-15 electrodes, conforming to Grade 260 of MIL-E-986B specification, were checked. Impact properties were found to be low in the stress-relieved condition. These electrodes have a chemical composition of Ni-Mo-V.

Manganese-moly electrodes, E-9016 and E-10016, were checked and again impact properties of stress-relieved welds were not satisfactory, especially when tested at sub-zero temperatures.

Various combinations of alloys using a low hydrogen type of coating were made and tested. Three different electrodes were developed with satisfactory properties in both the as-welded and stress-relieved states.

Some work was done to determine the influence of electrode size and weld metal chemistry on impact properties.



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Quotes *(continued)*

HOW TO use steel effectively in machinery was the subject discussed by **Omer Blodgett** before the American Welding Society.

The paper presented material never before published and developed by the author to aid manufacturers of machinery in using welded steel construction to advantage. It included a method of specifying welds to meet strength, rigidity and fatigue requirements. Through experience with many machinery manufacturers in different parts of the country, he has evolved some interesting ideas, contrary to what is commonly held to be good practice, on the placement of materials for the most effective use of the inherent properties of steel. He also covered fully methods for the most economical fabrication of welded design. Some of these included new short cuts, such as nomographs and calculators, for determining weld size and weld cost.

• • •

AUTOMOTIVE applications for Zytel nylon resin were given in an SAE paper by **John D. Young.**

Nylon is a generic term for a group of materials known technically as polyamides. The Du Pont Company offers nylon in three basic forms: textile fibres, monofilament and molding powder. Applications for nylon textile fibres range from ladies' hosiery to automotive upholstery materials and heavier industrial fabrics. Monofilament finds extensive use as bristle in a variety of brushes and for fishing lines, leaders and the like. Nylon molding powder, with which this paper was concerned, is used for the manufacture of literally thousands of items by injection molding or extrusion techniques. To eliminate possible confusion with other basic forms of nylon and to identify Du Pont nylon molding powder, the name Zytel has recently been adopted for this material.

The importance of molded Zytel nylon resin as an engineering material in the automotive industry stems from its excellent combination of properties plus unusual processing characteristics which permit the economical and accurate production of intricate shapes. Nylon affords economic advantages over other materials in many cases because of (1) rapid mass production injection molding; (2) lightness of weight (which means no. parts per pound); and (3) superior performance.

It is nylon's combination of properties that makes Zytel so suitable. There doesn't seem to be much similarity between the hinge pin in a lady's compact and a wheel bushing on an army tank. Yet, nylon has met the engineering requirements of each of these applications.

Nylon has outstanding mechanical strength. The physical property tables show the material to have an Izod impact in excess of 1 ft lb per inch of notch, which is considered excellent for a rigid material. It has good tensile strength, good shear strength and excellent flexural strength. The general toughness of Zytel is illustrated by its use in a passenger car door lock wedge. Each time the door is closed, this part receives a sharp impact from the mating part.

The resiliency of nylon provides damping for the vibrations in the door and lock assembly when the door is closed. Nylon has performed exceedingly well under these rugged conditions, and offers the additional advantage that it requires no lubrication, thus preventing damage to the passenger's clothing from grease.

Another case where excellent impact strength is important is in the front seat back stop used in many two-door models. This part acts as a bumper for the back of the front seat which is hinged to permit access to the rear seat. With a 250-pound man in the front seat, the loads on this particular part can be visualized.

The mechanical properties of nylon have led to its extensive use in gears. One important feature of a nylon gear is that it runs quietly. Because of this there is not the need for the extremely close dimensional tolerances which metal gears must have to reduce vibration and noise. By the same token, slight inaccuracies of tooth form and spacing in nylon gears are of less importance than with metal gears because of the resiliency of the material. In fact, several cases are known where an error in design was actually made, but the Zytel gear still operated satisfactorily. This does not mean that the correst design is unimportant, but rather that the designer has greater latitude.

In considering the design of nylon gears, power transmitted is the first consideration. As a guidepost in gear design, preliminary tests have established that the safe working stress factor in the Lewis gear formula varies from 1700 to 4500 psi as the pitch line velocity is reduced from 4,000 ft per minute to 100 ft per minute. Additional studies on the theory of nylon gear design are now under way at the University of Michigan, and it is hoped to have further information on this subject in the very near future.

• • •

EXPERIENCES WITH the use of aluminum windings for dry type power transformers were given by **E. W. Tipton** at the AIEE fall meeting.

In 1951 the supply of copper was critically short, whilst the demand for transformers and other electrical machinery using large amounts of it was high. More transformers were needed than could be built with the copper allotted for that purpose. As a result, it was only natural that designers should look for a substitute. The only real possibility was, and is, aluminum. In contrast to reports of dwindling high grade copper ore supplies, aluminum ore is plentiful and the production facilities for aluminum were greatly expanded during the war. The effect of the relative cost of aluminum and copper was such that even before the postwar shortage of copper, designers had been investigating aluminum for electrical conductors.

So far as transformers are concerned, dry type power transformers offered certain advantages in the use of aluminum windings. The lower conductivity of aluminum results in larger coils and a bigger core. In a liquid-filled transformer it may call for more insulation, more oil and a larger and more expensive tank. The case of a dry type transformer is of a simple, lightweight construction and its size is frequently determined by the size of steel clad switchgear with which dry type power centre transformers are co-ordinated in appearance. A somewhat larger core and coil structure does not add greatly to the cost of the case. Dry type power transformers use Class B insulation and a minimum of solid insulating material. The principal insulator is air. Consequently, a small increase in the size of the core and coils only slightly increases the cost of insulation. One other consideration is that dry type transformers are installed indoors. This eliminates one of the more serious problems in the use of aluminum windings because in such applications there are no aluminum-to-aluminum or aluminum-to-copper connections.

• • •

A DEVELOPMENT claimed to be one of the greatest advances in manual arc welding was given by **D. C. Smith, D. C. Helton** and **W. G. Rinehart** in a lecture before the Americal Welding Society.

American development of low hydrogen electrodes containing large quantities of iron powder in the coatings is about one year behid the rutile and iron oxide types. Some brands are now on the market and consumer acceptance looks very promising. Their increased weld metal deposition is perhaps the greatest single advantage of this type over the conventional E6016 type. Other advantages over the E6016 type are the low spatter, smooth steady arc on a-c, bright, smooth bead appearance, easy slag removal and straight profile fillet characteristics. Mechanical properties including tensile and yield strength, per cent elongation and reduction in area in the as-welded and stress-relieved condition, impact transition curves and deposition rates, are given.

Wallace Barnes SPRINGS

The Wallace Barnes Co Ltd.

HAMILTON, ONTARIO

New products & materials

New items which can help you on the job

A ONE-MAN operated automatic dispatch computer, which determines the most economical power distribution from each station on a system for the total load, is being built by **Westinghouse** engineers.

Station costs and other system characteristics fed into it will give the operator the most economical generation.

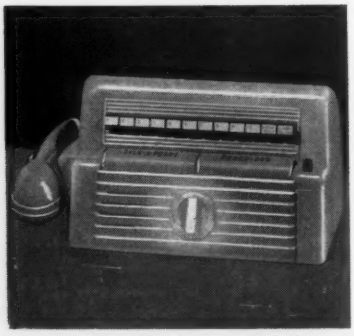
Individual station operators will receive this information by telephone or teletype and act accordingly by raising or lowering their power output. (200)

• • •

UTILIZING their newly developed principle of Automation, the new Talk-A-Phone Super Chief system is operated automatically by your own voice, eliminating the necessity of either party manipulating any controls during the conversation. Available in ten-station and twenty-station capacity, the new Talk-A-Phone Super Chief makes it possible for either party in a two-way "private" conversation to dispense with the manual use of the conventional talk-listen control.

The Super Chief system incorporates in its concept the Conference Control feature, developed expressly for **Automation.** It permits "private" conferences between as many as four stations without interference from any other station. There is no necessity for any of the parties to work any controls during the conference.

The new unit also features Automatic Traffic Control, which visually indicates at one station whether or not the other station you have selected to call is "busy" by red, green and amber translucent glows. When the all-clear signal shows the voice can be transmitted, but it is stopped on any busy signal. (201)

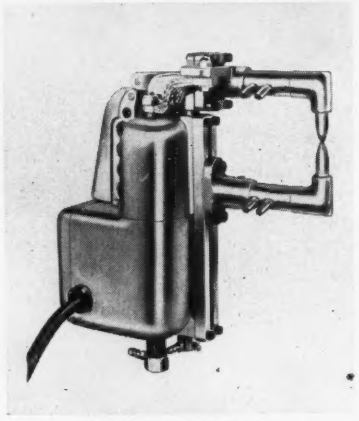


A new intercom from Automation

CLAIMED to outperform any other portable electric welder now on the market, the new heavy-duty "Hi-Amp Model 5403" is designed to give a higher rate of production on light gauge metals. According to the manufacturer, **The Sittler Corporation,** the model includes features that make it possible for a not-very-experienced operator to use the welder successfully.

The principal feature is its built-in electronic thyrotron timing control and solenoid contactor. This precision-type timer gives a welding accuracy from 1/10th of a second to a full second, thus preventing any danger of burning through the work.

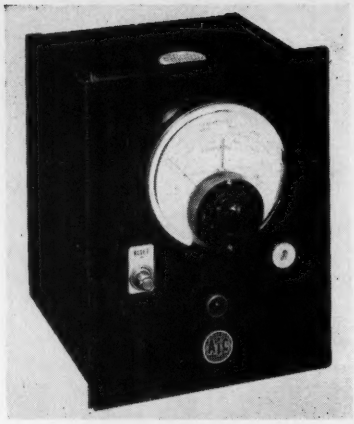
An unusually wide throat depth of 6 in. can be extended to 18 in. by the use of extension arm accessories. The welder's opening is easily adjusted from 3 in. to 11½ in. Both transformer and welding arms are water-cooled. Welder output is 3 amps for secondary open circuit voltage and over 20,000 amps for short circuit. While the welder weighs only 55 lb and can be moved about by hand, its carrying handle can be used with a sky hook. A floor stand is available for foot operation. (202)



Hi-Amp portable welder

• • •

OPERATING on a current of less than 1 microampere, a new temperature-indicating, electronic, contact-controller is said to automatically hold and control process temperatures as high as 2,500 deg F to within ±1% of scale. Called the AIC Indicator/Controller, it provides both straight cut-off and simple on-off control as required for industrial furnaces, ovens, tanks, or similar types of production equipment and machinery where temperature control is vital to product uniformity. Manufacturer is the **Automation Instrument Corporation.**



Temperature controller/indicator

Easily installed, the instrument consists of two separate units housed together in a single compact case 6 in. x 7⅜ in. x 5⅝ in. A pyrometer unit indicates the temperature under control up to the control point. An electronic control unit opens and closes the load relay regulating fuel supply to the controlled process. Capacity is 5 amperes at 115 volts.

Instrument can be surface or flush mounted. Its case is pressed sheet steel with plexiglass dial face for 3½ in. scale. Plain panel has single setting dial, switch to re-set control for straight cut-off, and red jewel light indicating whether instrument is on or off. Flick switch located inside case gives choice of cut-off or on-off type control. (203)

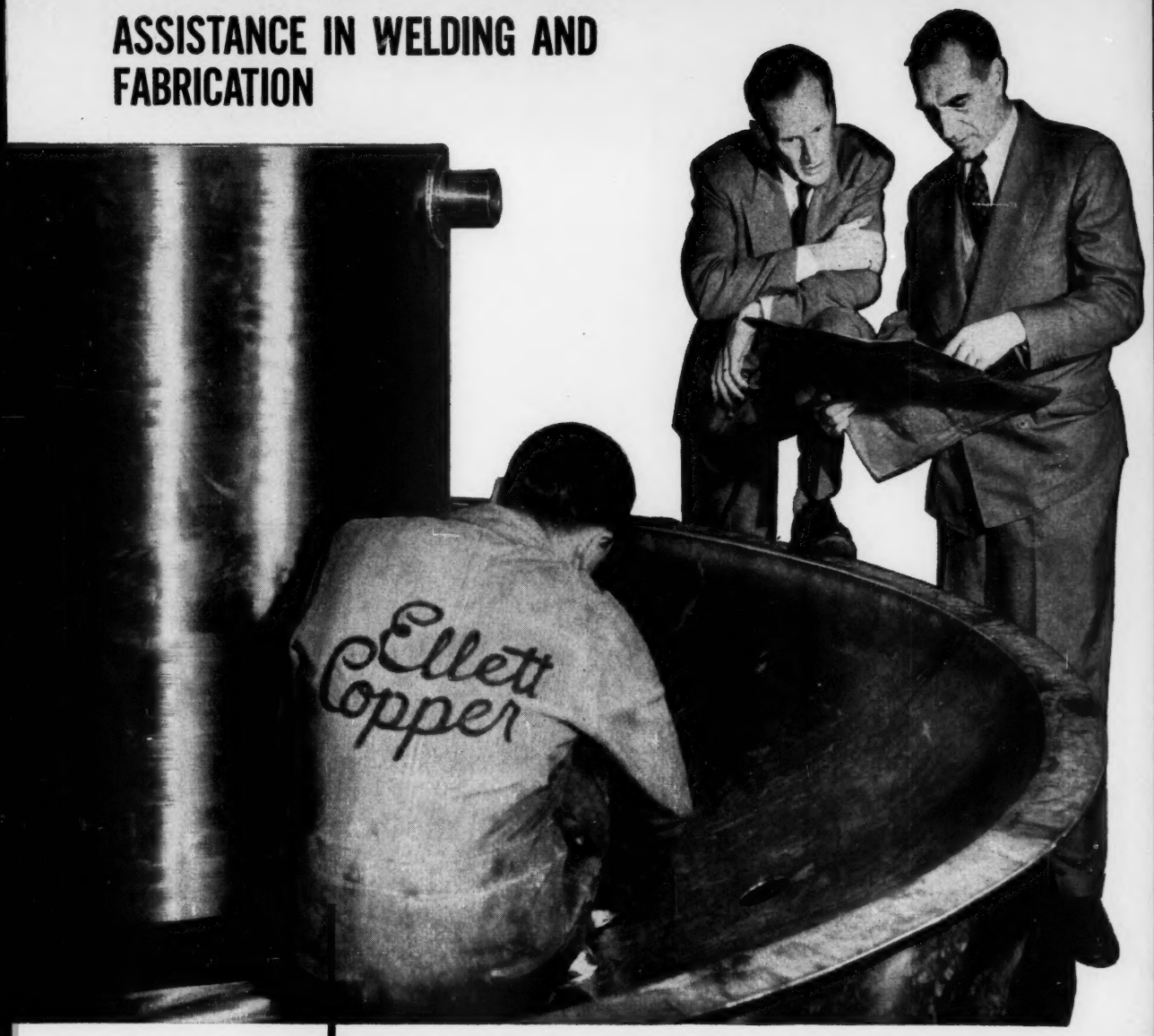
• • •

NEW REFLECTIVE sign material, called **Grotelite SS Reflective Sheeting** now available in Canada for the first time, is an approved smooth surface reflex reflective material of an acrylic formulation. It is processed so that it makes the surface an optical system having over 26,000 minute lenses per square inch.

The material has exceptionally good target value, long distance legibility and sufficient angularity for all practical purposes. Its water-repellent finish also resists dirt and dust making it self-cleaning in the rain. Accelerated tests in weatherometer and fadometer units as well as actual weathering tests have established that the sheeting will withstand all extremes of temperature and humidity.

Available in yellow, red, silver (white) and green it has been accepted and used by many states in the U. S. A. along with highway markings. (204)

ASSISTANCE IN WELDING AND FABRICATION



INCO Research Engineer at an on-the-job conference in the plant of Ellett Copper & Brass Co., Ltd., Vancouver, where work progresses on a nickel-containing stainless steel bottom for a brew kettle.

Let INCO be of service* to you

The aid in welding and fabrication given on the job illustrated above is typical of the personal assistance available to Canadian industry through INCO service. Through this service, INCO puts its facilities, personnel and experience to helping solve the many metal problems which occur in the never ending search for better products. Take advantage of the wide range of practical experience and background information available through INCO Research Engineers . . . if you have a metals problem with any of *your* products, let INCO be of service to you.

**Information involving corrosion, fabrication, foundry problems, high and low temperature service and metals selection.*

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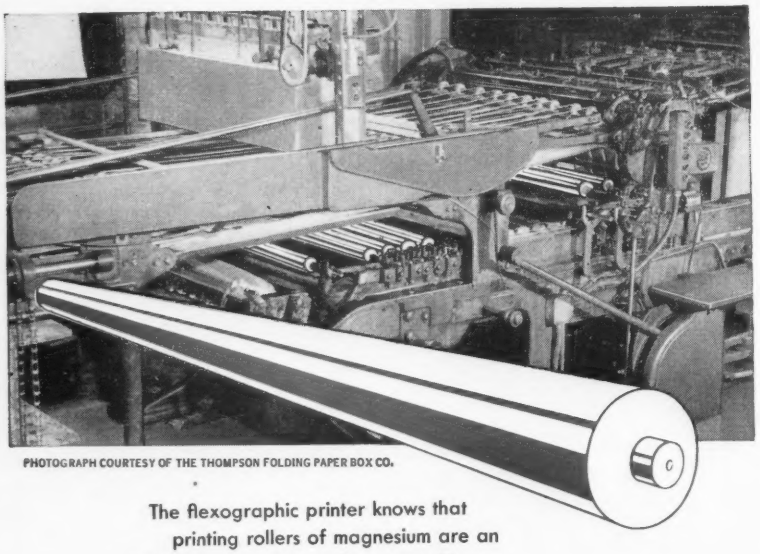

PHOTOGRAPH COURTESY OF THE THOMPSON FOLDING PAPER BOX CO.

The flexographic printer knows that printing rollers of magnesium are an efficient and money-saving proposition.

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The strength and machinability of versatile MAGNESIUM when combined with its light weight permit almost limitless industrial applications in product and equipment.

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Letters

Readers' viewpoints . . .

● I want to thank you for your splendid article on the Enjar wheels as published in the November issue of DESIGN ENGINEERING. The material is accurate and well written.

It is interesting to note that the engineering mind has changed in its approach since I first encountered it about 40 years ago. Now it says, "we can predict with absolute accuracy how this railroad wheel will perform!" That was said by one of the U. S. Rubber Company's senior engineers at a conference at the University Club in Detroit about the Enjar wheel of couple of years ago.

Your article on Enjar is very timely as I understand two separate groups representing financial interests . . . are coming to see me this month to discuss . . . active development of the Enjar wheels.

Many thanks for everything.

Windsor JAMES M. MACLEAN

● Your September issue carries under VIPs, some considerable comment on the engineering services performed by Mr. J. L. Miller on Canadian Western Pipe Mills' new plant at Port Moody, B.C. It is believed that in the light of the facts stated below, you may wish to correct the impression left . . .

The engineering contract with Canadian Western Pipe Mills Ltd. was negotiated in the name of B. D. Bohna, J. L. Miller and Co. Limited. This company was formed in early 1953 and is owned equally by: B. D. Bohna and J. L. Miller, consulting engineers, Vancouver; John J. Gould, consulting structural engineer, San Francisco; and W. R. Barton and E. D. Arndt, consulting mechanical engineers of San Francisco.

Without detracting in any way from Mr. Miller's contribution to the project, it should be noted that responsibility . . . was carried out as follows:

Market studies and project management, B. D. Bohna. Civil design, J. S. Slater. Structural design, B. P. Wisnicki. Structural consultant, John J. Gould. Architectural, W. F. Pratt. Electrical design, T. A. G. Beeching, R. E. Clay. Mechanical design, S. M. Heyman. Field supervision, M. R. Leitch.

B. D. BOHNA,
President, General Mgr., B. D. Bohna and
Vancouver *J. L. Miller Co. Ltd.*

DESIGN ENGINEERING regrets any mistaken impressions its item on Mr. Miller may have caused.

Body by Wilson

Vibrin delivers longer life, lasting beauty in truck bodies

THE PACKETTE, the smart parcel delivery truck shown above, will soon be making its appearance on Canadian streets.

Its initial appearance will be good, because of the care given to its design and construction by Wilson Motor Bodies of Long Branch, Ontario. And its appearance after thousands of miles of hard usage will be just as good, because the Packette's body is molded from reinforced Vibrin, Naugatuck's polyester resin.*

Truck bodies — or other items — made of glass reinforced Vibrin cannot rust or be dented. They are light in weight, many times stronger than steel for their weight, and easily repaired should damage occur.

Most important to manufacturers of many different lines, it is relatively easy and economical to get into production with Vibrin. Pressure and heat are not required to form this material, so molds and tools can be relatively inexpensive.

Vibrin cuts weight, cost, and production time on dozens of different jobs — especially where short runs are required. Besides truck bodies, Vibrin is finding wide acceptance for aircraft parts, translucent sheeting, fishing rods, machine housings, sports car bodies, and chemical piping, to name but a few.

You can look to Vibrin to cut manufacturing costs, to improve present products, and to give reality to new ideas, which might not be practical with other materials.

For complete information about Vibrin, call or write Naugatuck Chemicals in Elmira, Ontario, or branches shown below.

**Molded for Wilson Motor Bodies by Fleet Manufacturing Ltd., Fort Erie, Ontario.*

Other NAUGATUCK Plastics:

MARVINOL

Vinyl resins offering good physicals, easy processing, low temperature flexibility, and resistance to oils, acids and wear.

KRALASTICS

Molding and extrusion compounds combining rigidity with exceptional toughness.

Naugatuck Chemicals
DIVISION OF DOMINION RUBBER COMPANY LIMITED
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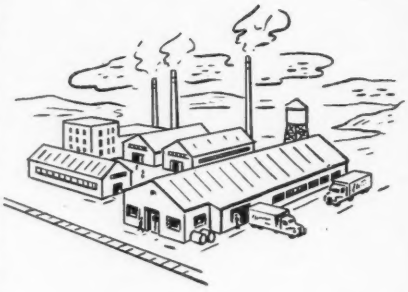
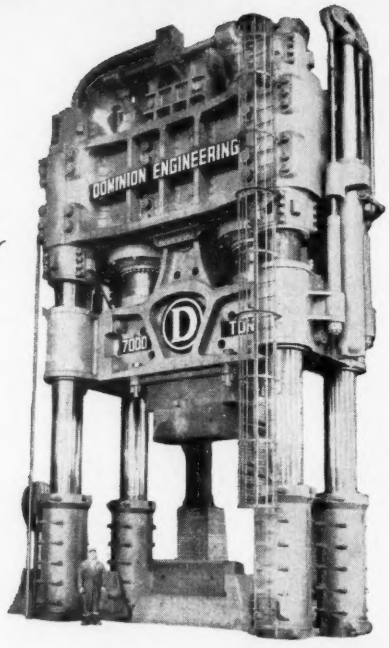
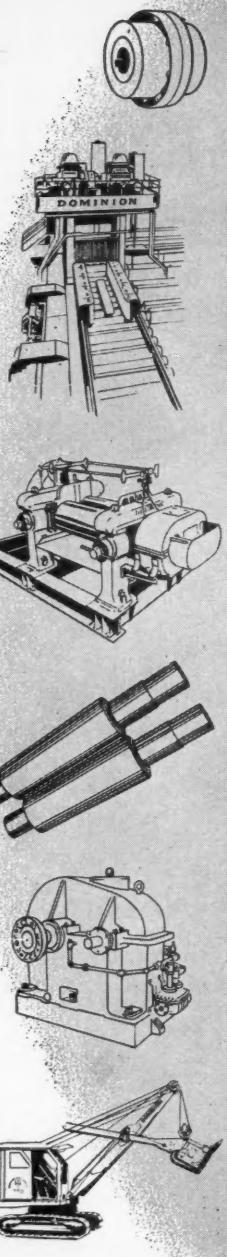
In Canada's heavy industry

DOMINION

plays a major role







DESIGNED, manufactured and installed by Dominion Engineering Company Limited, this 7,000 ton hydraulic forging press typifies Dominion's operations in the supply of heavy machines for industry. These include rolls, rolling mills, and machines for the production of rubber and plastics. The manufacture of transmission equipment and power cranes and shovels also forms a substantial part of Dominion's business. In addition, machinery for the pulp and paper industry, for mines and for hydro systems, carries the Dominion name to all parts of Canada and throughout the world.

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- Quickly the Reader's Service department will be working for you. All available information will be mailed at once to help you build a useful up-to-the-minute library from the technical booklets, pamphlets and pictures prepared for your use.

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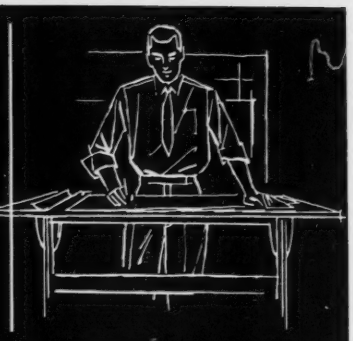
OVER 20,000 QUALITY FORGINGS

from **one** precision-made die . . .



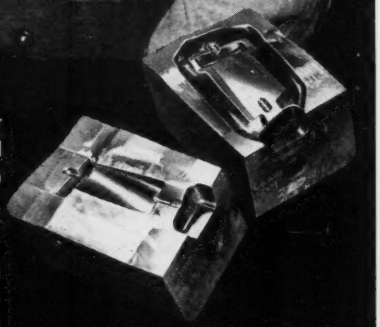
Dies are carefully hand-finished to maintain precision tolerances and high surface finish in the forging.

The operator of this die copying machine is making a duplicate die. This die will be used in a 3000 lb. drop hammer. It will produce more than 20,000 pieces, holding them to accurate, precision tolerances.

CANADIAN STEEL IMPROVEMENT recognize die-making as the key to precision forging and lower production costs. From the initial drawing—to the master die—to copies of the master die—every step is carried out with precision accuracy—to produce a quality forging.

CANADIAN STEEL IMPROVEMENT can forge parts to commercial, close or precision tolerances. In comparison to other methods, C.S.I.'s modern forging technique can save thousands of production dollars—literally cut delivery time in half. And most important—from the standpoint of product improvement—every part gains that immense structural strength which only quality forging can impart.

Take a critical look at your present part production methods. Take the parts to C.S.I.—see if they can't be forged cheaper—faster—stronger.



When finished, the dies are heat treated under careful control to obtain the required hardness and tensile properties.

CSI **CANADIAN STEEL IMPROVEMENT**
LIMITED

HORNER AND SECOND AVENUES, ETOBICOKE, ONTARIO.

Alloy and Stainless Steels
High Temperature Alloys
Titanium · Aluminum

5508

Patents

Some new ideas win protection in Canada

A QUEBEC city inventor, Gerard Robitaille, on August 2 obtained Canadian Patent No. 515,152 covering a new endless-tread vehicle he invented. It has three treads carried by four parallel drums extending across a large central cavity in the body of the vehicle. The drums are journalled in the side walls of the cavity.

Three traction rings on the two end drums engage the three treads like sprockets. The additional drums are geared to the end drums, and one of these is driven by gearing from a motor. Two traction rings on each of these drums lie between the treads and two lie on the outside of the treads. The gearing is staggered from side to side of the body for successive drums.

• • •

THE PROBLEM of preventing rotation of the master crank pin bearing assembly in radial aircraft engines is dealt with in Canadian Patent 515,065. Issued on July 26 to Nordberg Manufacturing Company of Milwaukee, this patent covers the idea of inter-connecting each pair of opposite knuckles with a rigid tie-link connected to cranks on the knuckles.

The crank pin extends through an elongated hole in each link, and the links are all spaced from the bearing along the crank pin, so that each link needs to be only wide enough to pass around the crank pin and need not pass around the whole bearing. This saves much space. The idea of the links is to maintain each pair of opposite connecting rods at the same angle with respect to the master bearing, thus preventing rotation of the master bearing on its own axis as it gyrates. The inventor is Donald I. Bohn of Pittsburgh.

• • •

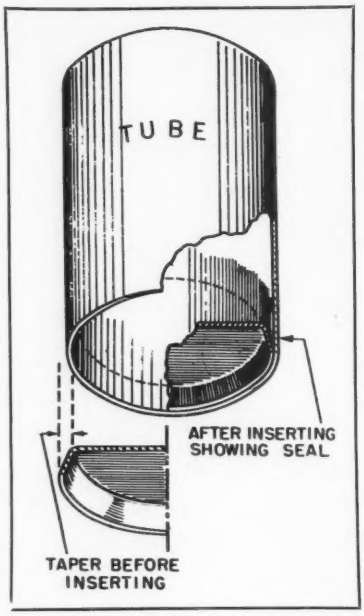
A NEW development in fan blades is covered by Canadian Patent No. 515,235, issued on August 2 to The General Electric Company Limited of London, England.

The blades themselves are formed from a single flat piece of rubber or other flexible material. It is bent to form blades by being pressed between specially shaped half-sections of the hub.

Each hub section has a number of projections that push the corresponding part of the flexible sheet into a fitting hollow in the other hub section.

The inventor: Walter M. Cranston of Birmingham, England.

A PRODUCTION technique for closing the ends of plastic tubing to make containers has been patented by Extruded Plastic Inc., Norwalk, Connecticut. The invention, disclosed in Canadian Patent 516,102, issued August 30, 1955, replaces the usual methods of either cementing a die-stamped disc to the end of the tube or cementing inside the tube end a heavier sheet-stock disc.



DESIGN ENGINEERING PICTURE

Both these old methods suffer from the fact that slight dimensional discrepancies reduce the strength of the bond and may require additional operations.

According to the patent, a disc having a flaring skirt is used. The end diameter of the skirt should be greater than the internal diameter of the tube and the diameter of the disc itself should be less than the inner diameter of the tube. The disc is sealed in the tube by inserting the disc and placing the end of the tube on a thin layer of a solvent for the plastic. The solvent rises between the skirt and the inner surface of the tube by capillarity and makes a uniform seal. The tube is removed and the solvent allowed to dry.

The inventor: Charles E. Slaughter of New Canaan, Connecticut.

• • •

SPECIALLY designed to give warning of fire in aircraft engines nacelles, a new fire detection system is the subject of Canadian Patent 514,501, issued on July 12, 1955 to the inventor, Arthur G. B. Metcalf of Milton, Massachusetts.

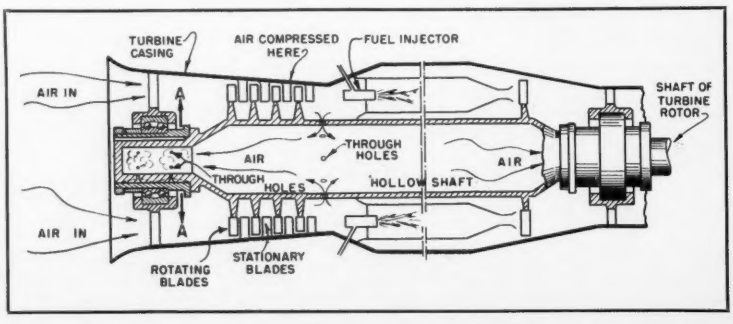
A number of photoelectric cells sensitive to the infra-red light of a flame, are mounted so that each overlooks a selected part of the nacelle interior. An optical filter in front of each cell filters out all light frequencies except the non-visible infra-red, and the cells are connected to an amplifier and a warning device or extinguisher that is operated when one of the cells "sees" a flame.

• • •

A COMBINATION of a fluid and a mechanical bearing, particularly suited for gas turbine engines, has been patented in Canada by the inventor, Paul Gerard of Paris, France. As described in Canadian Patent No. 516,034, which was issued on August 30, 1955, the gas turbine shaft rotates in a mechanical antifriction bearing at low speeds, as in starting the engine, but as soon as the compressor reaches its operating speed, both the mechanical bearing and the shaft turn in an air bearing and the mechanical bearing becomes practically inoperative.

The mechanical bearing—say, a ball bearing—is mounted with a clearance between its stationary part and the shaft support of the turbine, and air is fed from the compressor into the clearance space to produce the air bearing when the pressure reaches operating levels. The friction in the air bearing is much less than that in any antifriction mechanical bearing.

Another advantage of the invention is the cooling effect of the circulating air on the mechanical bearing.



DESIGN ENGINEERING PICTURE

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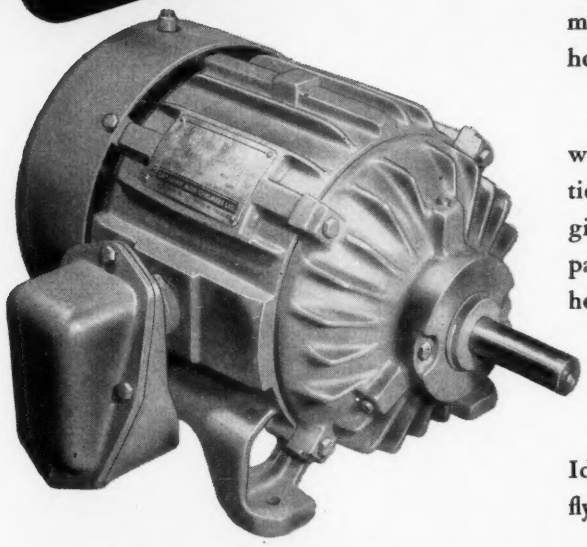

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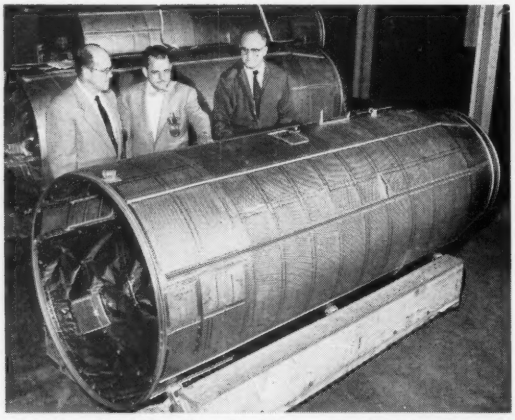
Design news in pictures

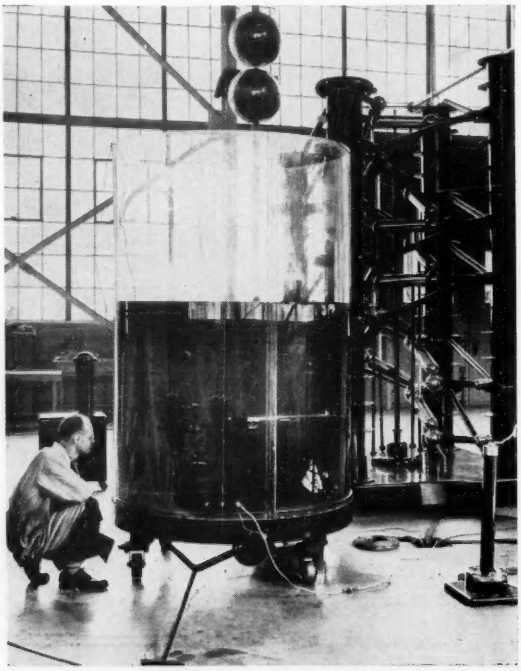
Some modern designs making news today

Small parts may be checked economically with portable Kodak contour projector, offering clear image, right reading. Simple staging of parts horizontally and vertically lessens operator training time for the unit.



Dimpled titanium shroud being examined by Convair staff will insulate J-57 turbojet engine from fuselage of the F-102 jet interceptor. New dimpled jacket is lighter weight, stronger, more rigid than smooth sheet titanium.

Ordered by British Aluminium for purpose of demonstrating capabilities of self-adjusting arc process for aluminum, all-welded, 72 ft aluminum yacht designed by Laurent Giles and Partners, is ketch-rigged, powered.



Transformer coil undergoes punishing electrical tests at Packard Electric Co., St. Catharines, Ontario. Test tank of clear Plexiglas, ½ in. thickness, permits test engineers to watch for breakdown from any angle.

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The Clover Plug has a free running thread of a special design. The taper at the contact point insures a perfect seal on all types of flare fittings. The flange or shoulder has a flat surface to seal against any housing, casting, etc.

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The Clover "Self-Aligning" Plug has a free running fit and will automatically lock under hand application sealing far beyond Military Specifications. The flared end will align itself to any type of flared fitting. When applied in a port opening the bead at the outer edge of the flange will completely seal under normal conditions.

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Photoelasticity

(Continued from page 18)

per fringe may be applied directly. CR-39 plastic, one quarter in. thick, has an approximate value of 320 psi per fringe, so that a tenth order fringe at a free boundary would indicate a stress of 3,200 psi. The stress value varies inversely as thickness, so that for CR-39 the calibration is approximately 80 psi per fringe per inch thickness. The commonly used plastics are subject to creep at room temperature. This means that full strain is not achieved the instant the load is applied.

While the stress *value* in the plastic model is likely to be much less than the corersponding stress in the metal prototype, the stress *distribution* is the same in both, provided the elastic limit is not exceeded and provided the deformations do not alter the load distribution. A tenth order fringe in CR-30 gives a boundary stress that is still within the elastic limit, but because of the low modulus of elasticity the stress may be limited to a lower value to prevent load lines from being shifted as the model deforms. When there is a section in the prototype at which the stress may be easily calculated, as in the neck of the crane hook shown in picture 7, it is usual to express the stresses elsewhere as a ratio to the known stress. In the photoelastic model this becomes a ratio of fringe orders, so that no calibration is required. Where this cannot be done, the prototype stresses are related to the model stresses with suitable load and size factors. With proper attention to technique and with the use of good equipment, an accuracy of better than 5% may be achieved.

In a 3-D stress system there will be, at any given point, three mutually perpendicular principal stresses. These will usually change in direction and value, along any given line, so that if the beam of polarized light uses this line as its path the resulting fringe number will be an average of stress rather than a maximum value. This difficulty may be avoided by using a very thin slice. Then, if the stress at a particular point is required, the slice may be taken in a direction that will include the principal stresses at that point. Sometimes a slice may be selected in which all points have their principal stresses in the plane of the slice. For example, a slice at a free boundary, taken parallel to the surface, will contain principal stresses. However, the stress gradient may be very high at the surface and if a sufficiently thin slice is taken the fringe order will be quite low, requiring accurate interpretation of partial fringe numbers.

One method of obtaining slices is to "freeze" the stresses in a 3-D model and cut the required slice from it. The special plastics for this purpose are slowly heated to about 200 deg F, loaded while still in the oven and cooled under load at a rate of about 4 deg F per hour. The material may be pictured as a wire grid filled with wax. At the elevated temperature the grid is elastically deformed under load and held in this position permanently when the wax cools and becomes solid. Careful slicing of the model does not disturb the deformations and the fringe pattern remains unchanged for years. The best material for this has been Fosterite, developed by the Westinghouse Corporation. It

shows no time edge stress, no relaxation of the frozen stress, and when loaded at 185 deg F, is 22 times more sensitive than CR-39 at room temperature. However, its modulus of elasticity is low and small fringe orders are required to prevent excessive deformation. However, Fosterite is no longer available from Westinghouse and the newer Epoxy resins are now used. These are obtained in liquid form from the Ciba Company, Union Carbide and Chemical, Houghton Laboratories, or other source, and are cast to shape by the user. While it is convenient to cast the plastic to the desired shape and size of the model, allowing just enough for machining, there are some problems and difficulties in obtaining a stress-free and optically satisfactory casting. However, in spite of difficulty, some complicated stress problems of commercial importance have been studied in this way.

Picture 8, shows the oven used for frozen stress work in the Department of Mechanical Engineering at the University of Toronto. The controls above the oven are used to hold steady temperatures and to provide a constant rate of temperature increase and decrease, which may involve a heating cycle lasting 24 hours or more. Inside the oven is a fixture that was used to provide hydraulic pressure in a model. Each problem poses a different loading requirement, so there is no permanent arrangement. To the left of the oven doorway is a constant speed motor that is used for freezing centrifugal stresses.

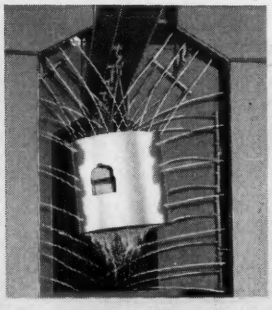
It's a "do-it-yourself"

Photoelasticity might come under the heading of a Do-It-Yourself for relatively simple but nevertheless common stress problems. A polariscope may be purchased at anything from $750 to $5,000 but the optics and light source for a diffused-light type can be obtained for $100. Some work depending on quality determining high stress concentrations may be done with cheap plastic-mounted Polaroid and an ordinary desk lamp. "Home made" loading frames are usually preferable to those commercially available and may incorporate refinements for ease of operation. The Chapman profiler for making CR-39 models retails at $255 to $365 (U. S. prices).

The equipment shown in picture 9 is the concentrated-light-source transmission polariscope in the Department of Mechanical Engineering at the University of Toronto. Operating controls are grouped at the viewing station and permit all adjustments to be made once the model has been placed in the straining frame. Some of the components are: A, mercury lamp; B, straining frame; C, the model; D, Polaroid and quarter wave plate; E, focusing lens; F, a turret providing a ground glass screen, a 4 x 5 film holder, and a clear glass tracing frame. The instrument at G is a special photometer that "looks" at a small area of the fringe pattern to establish fringe orders and fringe spacing, and is useful in the exact determination of the isoclinic angle at a given point in the model.

While it is true that some stress problems may be studied with simple equipment, the facilities of a well-equipped photoelectric laboratory with an experienced operator is more likely to produce consistently reliable results. Most universities now have polariscopes, and the number of private companies operating photoelastic laboratories is growing. There are still stress problems for which photoelasticity does not work entirely. A wise operator properly recognizes these limitations, but photoelasticity is a valuable tool for the stress analyst whose needs are economic, safe design. ★

C-I-L Hi-Bake System gives Beatty Washers long-life finish



Seeking an ever more durable washing machine finish, Beatty Brothers turned to C-I-L for expert advice both on finishing materials and methods of application. C-I-L Paint chemists found the answer in their new 4701-8 Hi-Bake Primer in a specially adapted form for flow-coating application. The final topcoat of CILUX Hi-Bake Enamel results in a gleaming, tough and durable finish characteristic of a C-I-L system.

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At left, a Beatty washer is flow-coated with C-I-L 4701-8 Hi-Bake Primer.

Photo courtesy of Moore Air Equipment, Ltd., London.

For expert advice on industrial finishing problems, whether they involve a specific problem or operation or a complete production line finishing system for wood or metal, call or write your nearest C-I-L Paints Division District Office. Halifax, Montreal, Toronto, Winnipeg, Regina, Saskatoon, Calgary, Edmonton, Vancouver.

industrial finishes

C-I-L PAINTS

Chromating

(Continued from page 33)

There is no top limit to plate thickness for chromating, but it has been observed that generally, where a chromate film is to be applied, additional plate beyond a thickness of about 0.0007 in. is of little additional benefit corrosion-wise.

Die castings are pretreated by, first, a conventional cleaning procedure such as is used preparatory to plating. This is followed by an acid dip, such as 1 or 2% sulfuric acid.

For galvanized iron, the following two pretreatments have been found to be very effective.

Caustic soda, 3 ounces per gallon, at 160 deg F.

5% phosphoric acid plus 5% of water-soluble organic solvent, at room temperature.

Simple type treatment

The great majority of treatments for zinc and cadmium are of the simple immersion type, operating within a temperature range of about 60 to 120 deg F. Treatment time is usually between about 5 seconds and 1 minute, although in a few cases is as high as 5 or 10 minutes. A wide range of coatings is obtainable, from solutions of varying basic composition, containing anywhere from about 1 to 70 grams per liter of hexavalent chromium, and covering a pH range of 0 or below to around 3.5.

Treatments for Copper and Its Alloys are known as Group II.

Mixtures of nitric and sulfuric, or of nitric, sulfuric, and hydrochloric acids, have been used for a long time for brightening cupreous metals. Chromate treatments are mainly improved bright dips, having three principal advantages over the older mixtures:

Improved brightness

Passivation of the metal surface

Non-fuming solutions, eliminating the need for ventilation.

Several proprietary treatments for cupreous metals are available. At least one of these will produce not only a bright finish, but also heavier, more protective coatings. Recent work has shown that even heavier and more protective films can be obtained and that these can be colored with organic dyes.

An interesting use of chromate bright dipping of copper is where chromium is to be plated directly over the copper. Chemical polishing reduces the need for mechanical buffing. The thin chromate film which is formed is removed chemically from the copper surface, leaving it bright and receptive to the chromium plate.

Several proprietary treatments, similar in procedure and results obtained, are in use in Group III, treatments for aluminum.

Application is made by immersion, spraying, brushing, or swabbing. Coatings varying in appearance from clear to iridescent yellow or brown can be obtained from a single bath by varying the treatment time. Coatings build up slowly as compared to those on zinc or cadmium, with a gradual deepening of color. Excessive treatment time generally results in powdery and loosely adhering coatings, or a partial sloughing off of the coating.

Chromates for aluminum have been very rapidly accepted since the first proprietary treatment was introduced about four years ago. Coatings are suitable as either corrosion-resistant final finishes, or as paint bases. In the aircraft and other industries, chromate treatments have replaced chromic and sulfuric acid anodizing to a large extent. Chromates generally give better corrosion protection than anodizing and are equally suitable for paint bonding, yet are far simpler to operate and require much shorter treating times. Because coatings are extremely thin, machined parts can be treated without concern for dimensional change. In the electronics field, chromates have the advantage of low electrical resistance over electrolytic oxide coatings. Other advantageous properties include weldability, self-healing of scratched areas, and ability to be cold formed without flaking off. As with most other chromate films, the principal disadvantage is low abrasion resistance. Where surfaces are anodized for wear resistance and then partially machined, a protective chromate film can be formed on the machined area by a simple brushing operation.

Proper pretreatment before chromating is particularly important with aluminum. A variety of pretreating methods are available. The choice in any particular case is determined by a number of factors, principally, the amount and type of surface contamination, dimensional tolerances, the alloy being treated, and availability of equipment. Metal finishing plants that are set up for anodizing can use already existing cleaning facilities, with, perhaps, slight modifications. As with other metals, oil, grease, and other lightly adhering soil must be removed. Vapor degreasing, solvent wiping, emulsion cleaning, or hot non-etch alkaline soak cleaning are all used for removing this type of contamination. Oxide removal is desirable for maximum uniformity and corrosion resistance of the chromate film. Proprietary chromate deoxidizers, such as are used prior to spot welding, have been found very effective for this purpose. These are acidic solutions containing chromic acid or dichromates, which dissolve oxides but do not attack the metal. Where etching of the metal is permissible, oxides and surface soil can be removed in a single step by a hot alkaline etching solution. This is probably the most effective pretreatment method from the standpoint of complete removal of surface contaminants. Alkaline etching of certain alloys leaves a smut of alloying metals. If silicon, this is dissolved by a 3:1 nitric-hydrofluoric acid mixture. Other-

(Continued on page 60)

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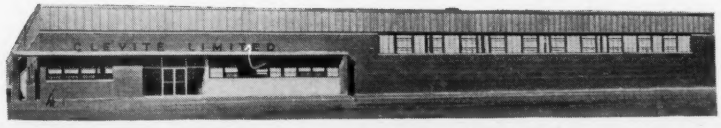

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Chromating

(Continued from page 58)

wise it can be removed by nitric acid (40 deg Baume, diluted 50-50 with water), or by a chromate deoxidizer.

Magnesium is the most active, chemically, and therefore the most readily corroded of the common industrial metals. It may be emphasized again in the case of magnesium that corrosion problems are serious only where there is exposure to moisture. Chromate treatments in Group IV protect magnesium against corrosion and are suitable bases for protective and decorative organic finishes.

Pretreatment methods include solvent and alkaline cleaning to remove oil, grease and lightly adhering soil; and both mechanical cleaning and acid pickling to remove oxides and other contaminants. Strong alkaline cleaners do not appreciably attack the metal. A number of different pickling treatments are in use, serving a variety of purposes. Straight chromic acid pickling dissolves oxide without attacking the metal. Various other pickles, for both wrought products and castings, remove up to 0.001 in. of metal. This metal removal carries away surface contamination and helps to produce a chromate finish of maximum uniformity and corrosion resistance. With sand castings, sand or shot blasting has the effect of accelerating corrosion of the magnesium surface. This effect is overcome by removing about 0.002 in. of metal in a simple sulphuric acid pickle.

Chromates, as well as other surface treatments for magnesium, have been developed and evaluated largely by the magnesium producers themselves.

Chromate treatments have become widely used not only because they fill a need for corrosion-resistant and paint-bonding finishes, but also because they are inexpensive and simple to apply. It has been attempted here to show how the basic features of the chromating process apply to a variety of treatments for a number of different metals.

The potentialities for further development are considerable. The Bright chromating of die cast zinc is an important new step. Chromate treating of silver to prevent tarnishing has been tried with some success and is now on the market. Chromate treating of ferrous products is a fertile field for investigation. It is known that chromate films can be formed on ferrous metals, but so far these have not been developed to the point of practical usage.

Chromates appear likely to continue to play a substantial part in the chemical finishing of metals. ★

Constant Spring

(Continued from page 23)

normal return spring. This offers the opportunity to reduce weight, simplify or provide semi-automatic operation for valves, control linkages, reciprocating mechanisms. Picture 5 shows a Neg'ator extension spring used as a carriage return device in a business machine.

Neg'ator clamps, expanded to any desired opening, are used to secure materials being joined or cemented; as a vise; to attach record cards and instruction sheets to parts and containers.

In picture 6 a Neg'ator clip provides an additional embracing pressure to assure firm electrical contact between coaxial connectors, Neg'ator springs provide continuous slot closure with one movable access over flat and convex surfaces picture 4. They function as barriers to air currents or light and they confine grit, dust and shavings in all kinds of machine tool enclosures. They conceal and protect live electrical conductors, machine beds and track areas. Since the Neg'ator springs counterbalance each other there is no unbalanced load on the equipment and little force is required to reposition the aperature.

In a variation of the A motor, with both ends of the springs mounted on bushings of the same diameter, the Neg'ator band provides a self-coiling expanded scale of great length in a fraction of the space which would otherwise be required by conventional drum or spiral scales picture 3. The absence of torque on the metering system due to the balanced tension between drums preserves great sensitivity and accuracy.★

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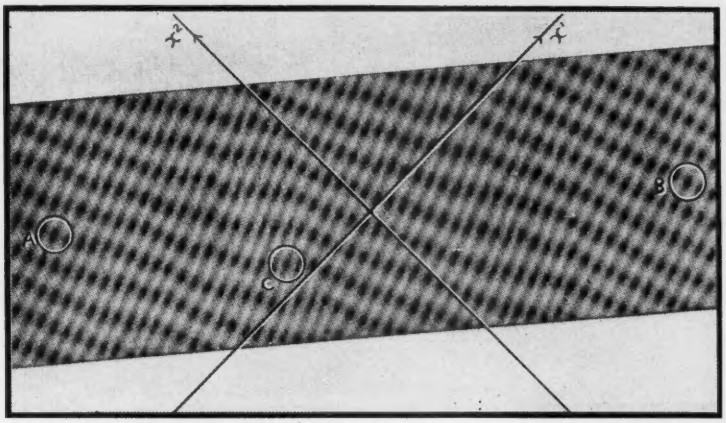

Axis of reference grid in Moire made with a board sample in a tensometer. The calculated strain is: $\epsilon x = 0.033$, $\epsilon y = 0.022$, $\gamma xy = -0.068$ at point A; $\epsilon x = 0.028$, $\epsilon y = 0.018$, $\gamma xy = -0.060$ at point B; $\epsilon x = 0.048$, $\epsilon y = 0.043$, $\gamma xy = -0.102$ at C.

Moire Pattern Measures Sheet Strain

Superimposed patterns show lattice motif

A TECHNIQUE for investigating strains in sheet materials has been developed by the Printing, Packaging and Allied Trades Association in the U. K. by which the strain is derived from first order measurements and not by difference.

Using the properties of superimposed patterns, the Moiré technique as it is called, measures the strain arising when a sheet material is deformed in its own plane, and estimates whether the distribution of the strain is uniform.

Whether these patterns are natural, as in the weave of textiles, or artificially imposed as a printed half-tone, each will consist of a printed motif repeated over a basic framework called the "lattice" of the pattern.

A pattern has certain rotational and translational repetitive characteristics, the latter defining the lattice of the pattern. The Moiré of two patterns is the pattern resulting from their superposition, photographically or otherwise, and also has repetitive features whose dimensions may be calculated from the lattice dimensions of the original patterns. The Moiré dimensions are large if the two lattices are closely similar, making the Moiré a sensitive measure of small differences between them.

If one lattice is regarded as arising from the other by a homogeneous deformation the Moiré dimensions can be directly related to the *strain* involved. When, for instance, a sheet material is deformed in its plane any pattern on it must deform in the same manner and the strain between any two stages of the deformation can be derived from the Moiré of the two corresponding forms of the pattern. This pattern may be a natural one, as with textiles, or it may be artificially imposed as a printed half-tone.

The method has the advantage that the strain is derived from first-order measurements and not by difference. Also the complete strain tensor of homogeneous deformation is obtained, and the whole field of strain where the deformation is heterogeneous. Using screens of 85 dots per inch, components of strain from 0.01 to 0.1 have been measured to better than 0.001. This accuracy could be improved by the use of a finer screen. ★

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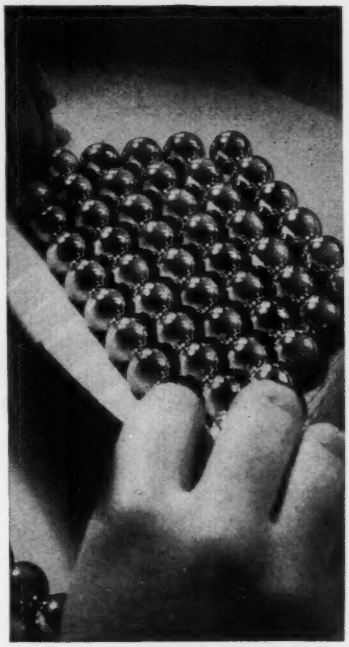

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Tape recorders

(Continued from page 29)

the equipment can be reproduced for analysis on any standard Ampex laboratory recorder.

Recorded information can be fed to machines that translate, such as card punch machines. Where punched cards, plotted graphs or other physical forms are required, taped data can be slowed down and translated into the desired form. The fact that taped data are electrical makes it possible to make these translations continuously.

In addition, recorded information can be fed to machines that act, such as process controls and machine tools. Any machine function that can be regulated electrically, can be controlled by tape. For example taped signals can open valves, regulate movements, determine positions, control timing.

An example of this type of equipment is the Model 306, used in the automatic machine control field which is becoming increasingly important in modern manufacturing methods. A pattern of work, for instance, in machining a part can be recorded on magnetic tape. Later the programmed instructions are fed into motors which can operate lathes, milling machines or other machine tools for the production of high-precision parts. An important potential use of this type of recording is the storage of information for a national emergency. Tapes could be distributed to manufacturers having automatic machine tools and the parts could be put into immediate mass-production, thus saving a great deal of tool setup time.

Use it for standard parts

Moreover, a manufacturer with branch plants throughout the country could use this device for the manufacture of standard parts.

Special advantages claimed for magnetic tape are: vast information can be stored in a small area; the data are replayable thousands of times; tape can be erased and re-used; and tape can be cut and spliced.

Other examples of standard instrumentation equipment include the Model 307 wide frequency range direct recorder with a frequency response of 100 to 100,000 cycles. Applications occur whereever a broad range of frequencies must be covered by one recorder. One example is the frequency analysis of vibrations that include high frequency components. Another is the recording of broad bands of multiplexed data. This model has been extensively used in FM-FM telemetering.

In the FM-FM telemetering field, the Model 500 also performs service as a low flutter, wide range recorder. Designed for four tracks, the recorder maintains extreme stability of tape motion while recording information in the frequency range between 100 and 100,000 cycles. It has the lowest flutter and wow characteristics of any tape recorder yet developed—less than 0.1% peak to peak by RDB standards.

Records low frequencies

The Model 303 records pulse width modulated signals varying between 60 and 1,000 microseconds in duration. This equipment records very low frequency signals and 45 or more channels of analogue information can be sampled, time multiplexed and recorded on a single magnetic track. Five such channels could accommodate as many as 225 channels of low frequency information. Information which might take weeks of human effort to analyze can be determined in a few hours by feeding it into automatic data reduction equipment.

In addition to standard models, combination recorders are also available. With modifications they meet the particular needs of the laboratory. Special equipment includes such devices as special loop adaptors, tape transports, automatic speed changing devices and multi-channel machines, using comointion data systems.

Many different models

In the audio field, tape recorders vary from the Model 300 professional studio type recorder to the 25-lb Model 600 portable recorder. Studio type tape recorders are used by radio stations, recording studios where phonograph discs are made from master tapes, in educational fields and in other professional applications. The Model 600, is the first portable tape recorder with the same professional standards as studio type recorders. It is used for home tape recording, in schools, in the medical field and other professional fields where portable equipment is selected.

High speed tape duplicators make possible the mass production of recorded tapes by speeding up the playing of the master tape from which copies are being recorded. The tapes can then later be slowed down on playback to normal speed. With the tape duplicator, 2,000 hours of playback material can be recorded in just eight hours.

New and fascinating applications of magnetic tape recording are constantly being developed. High amongst these applications is the recording of television video signals, which is being researched.

Automation in industry and commerce during the next decade will probably have magnetic tape as its remembrance medium: The field of magnetic memories has only begun. ★

Design Engineering

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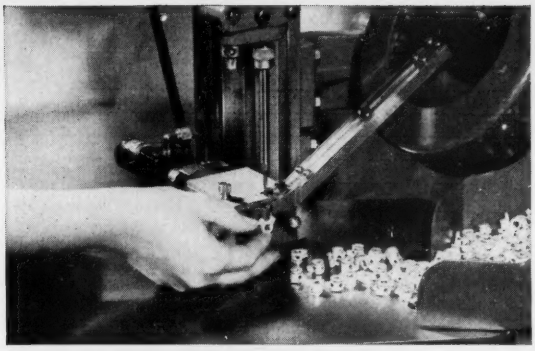
Tape problems have been overcome . . .

THE MAGNETIC TAPE system for recording and reproducing television signals is now near the end of one phase of laboratory development. Next it will undergo practical field testing by the National Broadcasting Company.

Just over a year ago, the first public demonstration of the system showed its ability to store on magnetic tape the sight and sound of television programs in either color or black-and-white. This made it possible to record programs for immediate or later playback. At that time, several technical problems persisted. They had to be overcome before the apparatus was ready for commercial development.

This new type of tape recorder will be useful, too, in the motion picture and theatre industry, in home entertainment and education, and in industry. An unlimited number of copies of tape recordings can be made quickly and cheaply. The recorded tapes can be kept (indefinitely) or electronically "wiped off" and reused.

Television tape recorders for home use are sure to come. They will allow the TV set owner to build a library of favorite television programs just as he can now collect phonographic records.



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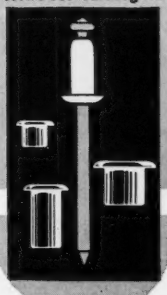

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File

New booklets and books written for you

A NEW 16-PAGE ILLUSTRATED catalogue from **National Broach and Machine** is available describing representative models in the company's line of Red Ring gear shaving machines, gear inspection equipment, gear lapping machines, gear grinding machines, self-contained broaching fixtures and broaches is available.

Ten pages of the catalogue are devoted to new machines and equipment the company exhibited at the recent NMTBA Machine Tool Show in Chicago. These include external gear shaving machines equipped for automatic and semi-automatic loading, internal and external gear speeders and nick testers, internal gear shavers, automatic gear gauging and sorting machines, gear checkers and rolling fixtures, and self-contained broaching fixtures.

Other Red Ring equipment described and illustrated in the catalogue includes fully auomated gear shaving and gauging equipment, large gear shaving machines for internal and external gears, gear lapping machines, gear and spline grinders and gear inspection machines. (205)

• • •

AN INFORMATIVE BOOKLET entitled "The Forging Process" has been released by **Canadian Steel Improvement.** It describes drop and press forging methods and equipment, outlines production steps, discusses the design of forging dies, and covers the characteristics of forgings and various forging materials. Standard tolerances for impression die forgings are also given in table form.

The booklet is written in clear, concise English by men who obviously know their business. It makes extremely interesting reading for those who are concerned with making metal parts. (206)

• • •

A TWO-COLOR ILLUSTRATED catalogue describing **Ventura Fans** for commercial and industrial ventilation is available from American Blower Corporation, Detroit 32, Michigan. Model B fans are for commercial and light-duty industrial exhaust installations; Model E fans are recommended for heavy-duty industrial applications.

The new catalogue discusses features of the V-belt-driven fans and their application. Tables of performance data are included which list electrical power requirements, delivery ratings at different static pressures, fan speeds, motor horsepower, nominal rotor diameter and net weight for each of the eight different sizes in the Model B line and the eight units in the Model E line.

Installation drawings are included in the new catalogue giving basic dimensions for the Models B, E. (207)

• • •

A MANUFACTURER of precision hydraulic and pneumatic components, **Aircraft Products,** have issued a bulletin on their new Series 4000 line of slide-type sequence valves for 3,000 psi hydraulic service. These valves feature extremely low leakage and low pressure drop.

It describes and illustrates these valves, which offer in stock models a standard maximum internal leakage of 15 drops per minute. Special models are available with maximum leakage values as low as five drops per minute. Also, the design and manufacturing techniques used by the company provide a pressure drop only one third as much as that found in conventional valves of this type.

This bulletin also includes complete details on: method of valve operation; models available (plunger operated and lever operated types); port sizes (AND-10050-4 or -6 ports for ¼-in. or ⅜-in. tube sizes); temperature ranges (from minus 65 F to plus 275 F for standard models, with wider ranges available in special models); and types of auxiliary relief valves (including full flow bypass and thermal type for use at cracking pressures ranging from 8 to 4,000 psi). (208)

• • •

A NEW single groove adjustable speed drive in Q, R and W belt sections, is announced by the American Pulley company. The new drive transmits up to 30 hp and allows as much as 100 per cent speed variations over the horsepower range of former drives having two or three belts. It is claimed that space and money can be saved compared with multi-V-belt adjustable drives. (209)

• • •

FEATURES OF PACKAGE DRIVES for speed control of machine tools and other applications requiring accurately variable speed over a wide range are described in a new bulletin released by **Canadian Allis-Chalmers.**

The drive, available in five cabinet sizes with drive motor range 5 to 150 hp, features magnetic amplifier generator field control; preset control for repetitive operations; control of all machine functions from one or more remote points, and full protection against overload and undervoltage. (210)

• • •

INFORMATION concerning complete line of G-E shaded pole motors ranging from 1.5 watts through 1/6 hp for fan and blower applications, is contained in a new bulletin available from Canadian General Electric Company. (211)

The 12-page bulletin contains a cut-away chart illustrating the construction.

Book Department

Bearing Lubrication Analysis

WRITTEN BY R. R. SLAYMAKER, Professor of Machine Design at Case Institute of Technology, this book is aimed at the design engineer who is not too well informed on the subject of sleeve bearings.

The book should, as claimed, lay a good foundation for the engineer who wishes to become more specialized in the subject.

The first four chapters deal with some very necessary theoretical aspects, such as viscosity (and other properties of oil) and the theory of hydrodynamic journal bearings as related to load-carrying capacity, friction torque, oil flow and temperature rise.

Chapter 5, Examples of sleeve valve design, will certainly help the design engineer choose a sleeve bearing given the shaft size, speed and load to be carried. It shows how to decide on the bearing length, clearance, method of oiling, temperature involved, kind of oil and bearing material.

Another most important section (Chapter 6) deals with the construction and life of bearing materials and gives a very useful reference table.

The subject of oilless bearings, that is, those in which there is no external supply of lubricant, is discussed in Chapter 7.

The book is well laid out, with sections clearly numbered in the decimal system and with sub-headings in bold type.

The illustrations are excellent except for the cartoon at the beginning of the book. Even if this had been good it would not have had any place in a technical book of this kind.

There is a useful tabular summary of the principal symbols used throughout the book. However, why not use the more customary psi for pounds per square inch and shear stress and T, not M, for torque?

The book is published by John Wiley at $5.00.

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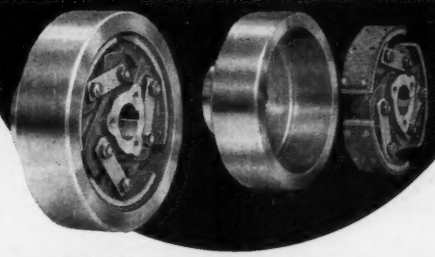

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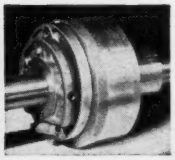

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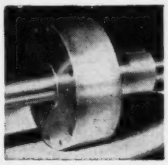

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Editorial

A New Association May Help Product Designers

A NEW ASSOCIATION may be formed in Canada soon. It will dedicate itself to more and better product development.

The idea brings with it, two immediate questions. Is there room for another trade association? And, can it hope for any positive and measurable result?

The Department of Trade and Commerce went to the trouble, recently, of listing all active trade associations in Canada. The list was immense! Over 1,200 groups were named; no wonder we have reached the stage where working members of the myriad trade associations are themselves grouped together in the Institute of Canadian Trade Association Executives! For a country with a population of only 15 millions, this begins to take on something of the comic opera look.

What is more, design is already represented by two groups. There is the National Industrial Design Council and the Association of Canadian Industrial Designers. With all this in mind, can a new association be described as necessary?

Surprisingly, perhaps, the answer is yes. After all, there are associations and associations; it seems reasonable to wonder if all the present ones are essential to Canadian prosperity. Certainly some are more useful and more worthy than others. The difficulty of an association lies not in forming it, but in making it do the right work. DESIGN ENGINEERING suspects that if it were possible to list only those associations which were necessary and sincere (which, of course, it is not) then the list would shrink dramatically. But from reports of the nature of the new product design group, it seems safe to say it would still win a place.

With it would stand NIDC and ACID. Both these bodies have done excellent work for a country still far from giving enough recognition to the need for fuller creativity in industry. But they are not complete.

NIDC is a government-sponsored council with some 23 members. It does much to educate designers and to publicize the need for better consumer-product design. But it is just a council. It does not yet have the broad, general membership that could bring all people directly or indirectly involved in product design into contact with each other.

ACID, too, has a restricted membership —at the moment of 30. This association aims primarily at setting professional standards for member industrial designers to reach. It is a professional qualification to belong to this group. So contact and discussion is limited to those people who are practicing industrial designers and who meet the standards ACID requires.

A new, much broader group which aimed to bring all influential people with a design interest together, could do a wonderful job. Engineers, designers, manufacturers, sociologists, teachers could all be included. Creative contact between these people coupled with lectures and social activities could achieve much.

There need be no contest between this new group and NIDC and ACID battalions. The three would find there is much for them to do together.

Why

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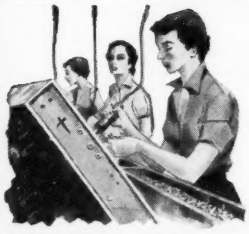
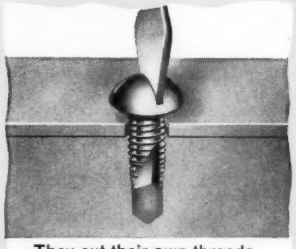
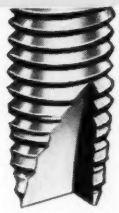


Shakeproof Thread-Cutting Screws offer you immediate assembly savings.



They cut their own threads, eliminate separate tapping operations completely.



This thread-cutting slot exposes a sharp, serrated cutting edge.

Shakeproof Thread-Cutting Screws actually work with true tapping action.

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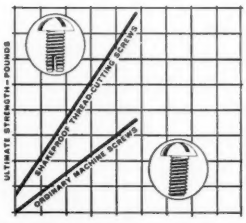
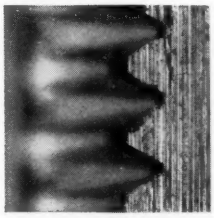


These hardened screws provide greater strength ... often permit use of smaller sizes.



Self-cut mating threads assure a tight, vibration resistant fit.

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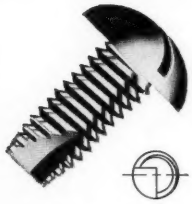
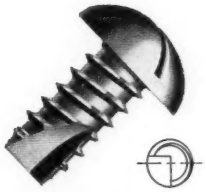
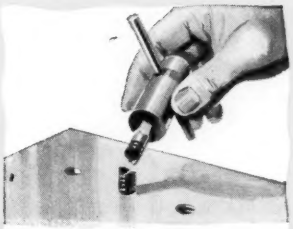


Type 23, with wider thread-cutting slot, is for use in metals and plastics.



Type 25, with spaced thread, is designed for use with plastic materials.



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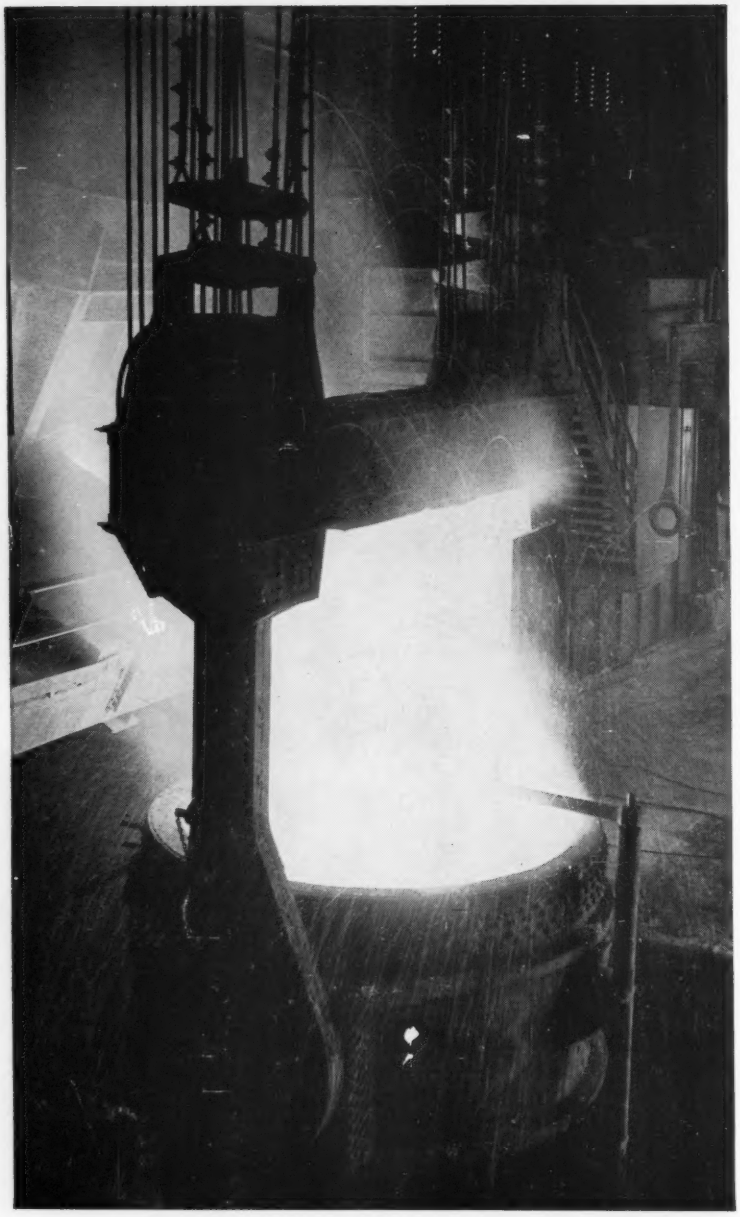

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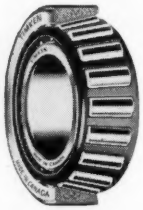

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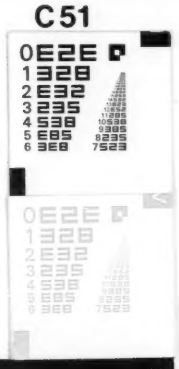
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